Value Analysis Report

SR 101 Roadway Stabilization

01-324700-Del Norte-101 PM 15.0/15.6 (KP 24.0/25.0)

Contract No. 53A0020
Task Order No. 183

October 2002

Prepared by
Value Management Strategies, Inc.

Value Management Strategies, Inc.

"Value Leadership"

Frederick Kolano, CVS
Senior Value Engineer

January 10, 2003

To: All Recipients of Final Value Analysis Report for the SR 101 Roadway Stabilization Project

Value Management Strategies, Inc. is pleased to transmit this Final Value Analysis Study Report for the referenced project. These copies are intended for individuals shown on the distribution list at the front of the report. Please distribute these copies as soon as possible.

This concludes the VA study activities for this project.

If you have any questions or comments concerning the final report, please contact me at (970) 242-5531.

Sincerely,

Fred Kolano, CVS

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Preliminary VA Study Report

SR 101 Roadway Stabilization

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SYNOPSIS

FINAL

This Value Analysis (VA) Study addressed the unstable SR 101 roadway in Del Norte County between PM 15.0 to 15.6 (KP 24.0/25.0), commonly referred to as the "Last Chance Grade." This segment of SR 101 traverses State and National Parks and is the major transportation link between Humboldt and Del Norte Counties. The roadway requires high maintenance and experiences frequent traffic disruptions due to deep-seated and shallow landslides.

Caltrans initiated this VA Study to identify alternatives to the 1995 Project Study Report (PSR), which addressed the above-mentioned problems. **The scope of the VA Study was limited to the existing highway corridor, with special focus on minimizing the park right-of-way takes and minimizing impacts to old growth trees.**

The 1995 PSR identified four PSR Alternatives. The PSR alternatives are to (1) Realign the highway in a tunnel behind the slide plane; (2A) Minor roadway realignment, and stabilize with a soldier pile tieback wall and slope stressing; (2B) Minor roadway realignment and stabilize with two soldier pile tieback walls; and (3) Major retreat behind the slide plane involving a through-cut. Each of these PSR Alternatives had a significant deficiency. This PSR was initiated as a result of joint concerns of Caltrans, the Del Norte Local Transportation Commission, and the public. PSR Alternative 2B was designated as the baseline against which the VA alternatives were evaluated.

The VA team identified three VA alternatives. The Project Development Team accepted VA Alternative 2.0. This alternative focused on constructing retaining walls that only address specific terrain instability locations. The performance of the alternative (based on the original concept and rated using a set of six performance measures) increased by 44%. Minimal right-of-way takes, combined with significantly less environmental impacts, resulted in this improvement. In addition, this alternative which could cost approximately $5,900,000, will save approximately $39,000,000 from the original concept project cost, because the length of retaining walls is significantly less than proposed in the original concept. The combination of improved performance and cost savings resulted in a value improvement for the accepted VA alternative of nearly 1000%.

Because the deep-seated slide cannot be stabilized by reasonable means, this VA alternative is not a complete fix to the terrain instability problems. However, it is acceptable to stakeholders and the National and State Parks. The accepted VA alternative would also be easier to program than the original concept; therefore, it can be constructed sooner.

EXECUTIVE SUMMARY

FINAL

INTRODUCTION

This VA Report summarizes the VA Study initiated by Caltrans District 1 and facilitated by Value Management Strategies, Inc. The subject of the study was SR 101 Roadway Stabilization from PM 15.0 to 15.6 (KP 24.0/25.0).

- 01-324700-Del Norte-101 PM 15.0/15.6 (KP 24.0/25.0)

The documents provided to the VA team included the 1995 PSR, the 2001 Preliminary Geotechnical Report, aerial photographs, and other technical data prepared by Caltrans District 1 representatives.

PROJECT DESCRIPTION

This purpose of this project is to identify and propose recommendations to mitigate operational deficiencies currently experienced on SR 101 from PM 15.0 to 15.6. The purpose was also to consider deficiencies experienced in the longer segment from PM 12.5 to 15.6. The proposed project is required to ensure the roadway will remain open to vehicular traffic. It was initiated as a result of joint concerns of Caltrans, the Del Norte Local Transportation Commission, and the public. The proposed project would be funded under the HA42 (Protective Betterment) Program.

SR 101 is a major transportation route of interregional and interstate importance. It is considered the "lifeline" of the North Coast, providing the connection between the Northern California Coast and the populated San Francisco Bay Area to the south, and Oregon to the north. SR 101 facilitates many important types of transportation, including tourism, emergency services, and transportation of goods to, from, and through the region. It is part of the National Highway System and is also a part of the Subsystem of Highways for Extra Legal Loads.

This segment of SR 101 has historically required significant maintenance effort to avoid road closure. The longer segment (PM 12.5 to 15.6) has been subject to traffic control for an average of 1,068 hours per year (12% of the time) over the past 10 years. The District has expended an average of approximately $60,000 per year on the shorter segment (PM 15.0 to 15.6) and approximately $640,000 per year for the longer segment (PM 12.5 to 15.6). During wet conditions settlement occurs, which requires frequent inspection and repair of the roadway. The long-term results of the settlement are poor vertical alignment and a rough ride for the traveling public. This segment of the roadway (PM 15.0 to 15.6) requires night monitoring during wet weather to provide timely response to abrupt settlement. It is anticipated that maintenance expenditures and the likelihood of another roadway closure would increase over time.

Geotechnical experts suggest that two types of catastrophic failure events are possible in the project area. One is caused by a major earthquake and the other by significant rainfall; either of these events could cause an estimated 3 to 10 feet of movement by activating the deep-seated failure plane. These effects would likely be major disruption of vehicular traffic, including a full roadway closure of at least one to two weeks. Lesser events, more typically caused by rainfall, have resulted in movements of 2-6 inches of movement estimated, causing disruptions for one or more days.

This section of SR 101 was constructed on the west-facing flank of a 300-meter high (1,000-foot) ridge, bounded on the west by the Pacific Ocean and on the east by Wilson Creek. The project is surrounded by the Del Norte Coast Redwoods State Park boundaries. Existing right-of-way widths vary throughout the project site.

The section of SR 101 proposed for reconstruction is a two-lane conventional highway with 3.6-meter (12-foot) wide lanes, and alignment is generally curvilinear. Vertical alignment is rolling, with a maximum grade of approximately 7%. The existing and future (2010) level of service is E.

PROJECT HISTORY

Stabilizing the roadway at the Last Chance Grade (PM 15.0/15.6) would be a Major Project (i.e., using Caltrans Programming Criteria such as costing more than $750,000). Projects exceeding $750,000 are eligible for programming in the State Highway Operations and Protection Program (SHOPP). A SHOPP project can be rehabilitation, a protective betterment, or an operational improvement; it cannot be capacity increasing or a new facility. Capacity increasing and/or new facilities projects are eligible for programming in the State Transportation Improvement Program (STIP).

The original project encompassing the location at the Last Chance Grade was referred to as the "Wilson Creek Bluffs" project, and it was initiated in 1987 to address nine areas of identified roadway instability. This project studied bypass alternatives between PM 12.5 and 16.5. An eastern bypass alternative was programmed in the 1992 STIP as a "long lead", not including construction funding. Due in part to impacts to parklands and old growth trees, and a lack of support from regulatory agencies and conservancy groups, this project was un-programmed in 1993.

A Corridor Study on SR 101 was initiated following programming of the Wilson Creek Bluffs project in the 1992 STIP. The Corridor Study considered all of SR 101, but it focused primarily on the section from PM 12.5 to 22.5. This study considered the cumulative impacts to parklands and old growth trees from both the Wilson Creek Bluffs project and a separate bypass project being studied at Cushing Creek (between PM 20.5 and 22.5). The Corridor Study identified an alternative that would avoid all parklands. This alternative was determined to consist of a 17-mile bypass with a cost of $580 million. Based upon the results of this study, the Wilson Creek Bluffs project was removed from the 1992 STIP (unprogrammed), and it was proposed to study SHOPP projects within the existing alignment that would address stabilizing the roadway. The section of SR 101 at the Last Chance Grade was considered the highest priority due to the slide complex containing five of the nine unstable areas. Studies to address this area were initiated in 1993, and a Project Study Report was completed in February 1995.

The current PSR for this project was approved in February 1995. It is classified as a long-lead SHOPP project. It has four alternatives: (1) Realign the highway in a tunnel behind the slide plane; (2A) Minor roadway realignment, and stabilize with a soldier pile tieback wall and slope stressing; (2B) Minor roadway realignment and stabilize with two soldier pile tieback walls; and (3) Major retreat behind the slide plane. In an effort to determine if the alternatives were feasible, a geotechnical study was initiated in mid-1998. Actual field investigations and engineering analyses were performed in 1999 and 2000. A final Geotechnical Report was prepared in May 2001. The geotechnical report concluded that the PSR Alternative 3, the through cut, was the only alternative that could be expected to be successful in addressing the deep-seated slide. Unfortunately, the impacts to park lands would be unacceptable.

The estimated project cost of the baseline PSR Alternative 2B minor roadway alignment and stabilize with two solder tieback walls is approximately $45,000,000.

PROJECT ISSUES

This VA study was assembled to identify alternatives to the 1995 PSR. The VA team was asked to limit their alternatives to the present Caltrans right-of-way within the corridor.

The following items were identified and addressed by the VA team:

- Potential impacts to Redwood trees
- Potential impacts to park lands within the corridor
- Short-term and long-term roadway stabilization
- Staying within Caltrans right-of-way

PROJECT ANALYSIS

The VA Study started with introductions of VA team members, Project Development Team members, and external stakeholders. Next, an overview of the project was conducted. The participants were then asked to identify, define, and rank performance criteria that would be used during the VA Study to measure an idea's impact on the criteria. Following this, the projects original concept was ranked against the performance criteria.

The VA team then discussed the project costs and analyzed the functions of the project. This led to brainstorming of value mismatches and the identification of approximately 60 ideas. Evaluation of each idea involved clarifying the idea, determining the idea's impact on the project's performance criteria, listing the idea's advantages and disadvantages, and determination of the idea's potential for cost savings or added cost. This analysis was concluded with an overall rank for the idea. Highly ranked ideas were designated as VA alternatives and were documented. The documentation included a description of the present and proposed concept, advantages and disadvantages, sketches, an evaluation of the alternative's impact on the project's performance criteria, and a detailed cost evaluation.

The FAST Diagram for this project shows *Access Counties* as the basic function. Key secondary functions used for brainstorming were *Align Roadway, Increase Road Stability,* and *Maintain Highway*. In several cases the project costs and performance criteria associated with the functions have been identified. This enabled the team to determine the relationship between the project functions and cost, and to confirm that the performance criteria are being satisfied.

The VA Team developed three VA alternatives for improvement of the project. The alternatives focused on two different ways to approach the slope instability problems. The third focused on a contingency plan that would allow for immediate response to a slope slippage. In addition, the team identified seven alternatives that were considered out of the VA Study Scope. These were developed to ensure that all possible options related to the slope instability were documented.

It is important to note that PSR Alternative 2B, the baseline used for the VA Study, was found to be incapable of resisting the forces of the deep-seated slide on which the roadway rests. VA Alternatives 1.0 and 2.0 are similar to Alternative 2B in the respect that they incorporate walls above and below the roadway, but at an incrementally reduced scope. They do provide a level of resistance to the shallower movement; however, not enough to resist the forces of the deep-seated slide. Because PSR Alternative 2B does not offer any economic advantage, it did not receive further consideration except to serve as the baseline for the VA Study.

A description of the accepted alternative and reasons for the rejection of the other two alternatives are described below. Summary lists of the VA alternatives and documentation of each VA alternative can be found in the Value Analysis Alternatives section of this report.

RESULTS OF THE VA STUDY

The Project Development Team accepted VA Alternative 2.0. This alternative will provide considerable performance improvement over the original concept (44%) related to less need for right-of-way takes and considerably less environmental disturbance. In addition, the accepted alternative will save approximately $39,000,000 from the original concept.

This conclusion was presented to the National and State Parks, the Del Norte Local Transportation Commission and Caltrans District 1 management. These organizations concurred with the conclusion. This activity demonstrated the usefulness of the value analysis approach toward developing consensus among organizations involved with the project area.

During the VA Study, the team identified seven "out of VA scope" alternatives. These were considered out of scope because they were not in or very close to the Caltrans right-of-way. These alternatives focused on bypass and tunnel alignments. Using these out of scope alternatives as a base, the Project Development Team performed further investigations and analysis of the bypass alignments to determine if a feasible alignment could be identified. The result of this analysis was that all bypass alignments that were studied had significant negative environmental impacts related to severe disturbance to the terrain and Redwood trees. Therefore, none were considered feasible.

Note: Cost estimates and Potential Savings do not include maintenance costs which may have a slight change on performance.

Accepted VA Alternative

Alt. No.	Description	Potential Savings *(Added Cost)*	Performance
2.0	**Construct Retaining Walls that Only Address Specific Terrain Instability** This VA alternative proposes to construct maintenance tieback soldier pile walls below the roadway to resist lateral shallow slope instabilities in areas of poorly consolidated materials with transverse and longitudinal cut-off drainage structures. Soil nail walls will be used along the slopes above the roadway to retain slide mass. Ditches above and behind the wall crest would capture upslope surface runoff and cross drains would convey the water downslope. This proposal is about one-third the length of the original concept proposal.	$39,030,000	44%

Rejected VA Alternatives

Alt. No.	Description	Reason for Rejection

Alt. No.	Description	Reason for Rejection
1.0	**Construct Retaining Walls Throughout the Project Limits**	This alternative does not resolve slope instability issues and would have more environmental consequences than VA Alternative 2.0. This alternative is rejected in favor of VA Alternative 2.0
3.0	**Augment the Present Maintenance Program with a Contingency Plan to Accelerate Road Damage Repairs on the Existing Alignment**	This alternative does not resolve slope instability issues. The project decision makers agreed that the contingency plan concept be forwarded to the District Maintenance organization as a best management practice to be applied to the project area.

RATIONALE FOR CUMULATIVE PERFORMANCE RATINGS OF THE ACCEPTED ALTERNATIVE

Performance Criteria	Accepted Alternative
Right-of-Way	Significant improvement related to little or no additional right-of-way needed to construct the accepted VA alternative.
Maintainability	Slight reduction because of limited ability to clear slide debris.
Environmental Impacts	Considerable improvement because of minimal impact to natural resources, including Redwood trees, and considerably less terrain disturbance than the original concept.
Aesthetics	Minimal or no change because existing views are maintained. Also, retaining walls can be designed with visual textures to minimize undesirable contrast.
Roadway Geometrics	Slight reduction because no alignment improvements are proposed in the accepted VA alternative.
Constructibility	Some improvement over the original concept, because a much shorter retaining wall length will be constructed.

PERFORMANCE AND VALUE IMPROVEMENTS

Value improvement is measured by the ratio of performance to cost. To establish value improvement, the accepted VA alternative is ranked against all of the project's performance criteria. This is done by the team assigning a score of 1 to 10 (10 is most desirable) for the VA set's performance against each of the

six performance criteria. Each score is multiplied by the weight of the appropriate performance criterion, and then summed to determine a total performance score.

The Performance Rating Matrix is shown on the following page.

PERFORMANCE MATRIX

SR 101 Roadway Stabilization

Caltrans

Criteria	Unit of Measurement	Criteria Weight	Concept	Performance Rating 1	2	3	4	5	6	7	8	9	10	Total Performance
Right-of-Way	Degree of Impact	29	No Build										**10**	290
			Baseline				**4**							116
			Accepted Alt.								**8**			232
														0
														0
Maintainability	Degree of Impact	24	No Build	**1**										24
			Baseline						**6**					144
			Accepted Alt.					**5**						120
														0
														0
Environmental Impacts	Degree of Impact	17	No Build								**8**			136
			Baseline			**3**								51
			Accepted Alt.									**9**		153
														0
														0
Aesthetics	Degree of Impact	12	No Build					**5**						60
			Baseline						**6**					72
			Accepted Alt.						**6**					72
														0
														0
Roadway Geometrics	Degree of Impact	9	No Build			**3**								27
			Baseline							**7**				63
			Accepted Alt.						**6**					54
														0
														0
Constructibility	Degree of Impact	9	No Build										**10**	90
			Baseline		**2**									18
			Accepted Alt.				**4**							36
														0
														0
														0
														0
														0
														0

OVERALL PERFORMANCE	Total Performance	Total Cost ($ mil)	Value Index (Performance/Cost)	% Value Improvement
No Build	627			
Baseline	464	45.0	10.31	
Accepted VA Alternative 2.0	667	5.9	113.05	996%

VA STUDY SUMMARY REPORT

VALUE ANALYSIS STUDY SUMMARY REPORT

INTRODUCTION

The Value Analysis Study Summary Report (VASSR) is a seven-page form used by the Caltrans VA Program Administrators for auditing and reporting purposes. The summary report is filled out portion by portion as the VA study progresses, and is submitted as part of the Final VA Study Report. If there are conditionally accepted alternatives after the Implementation Meeting, the VA Team Leader will follow-up with the Project Manager and DVAC on a regular basis to conclude the VA Study. Once the dispositions of the conditionally accepted VA alternatives are finalized, the VASSR and Executive Summary are updated and provided to the Caltrans HQ VA Branch for reporting in the Annual VA Program, and the VA Study activities are completed.

The VASSR includes:

VA Study Identification / Charter

The Project Manager and DVAC originally developed this page to initiate the project. It provides basic information to identify the project, a narrative description of the project, the need and purpose for the project, and the purpose of the VA Study. The information is updated during the VA Study be the VA Team Leader.

Participants and Schedule

This page identifies the VA team and other key participants involved in the VA Study. The schedule of key events is also listed on this page.

VA Study Proposed Alternatives

All VA alternatives are listed with their potential cost and performance changes. The VA team establishes sets of selected VA alternatives to provide reviewers guidance and added understanding of how the alternatives can fit together into a solution for the project. The sets and their cost, performance, and value changes are listed on this page. Cost savings and cost increases are totaled separately.

VA Study Accepted Alternatives

Accepted VA alternatives are listed with their validated cost and performance changes. The total impact of the accepted VA alternatives is determined and the cost, performance, and value changes are listed on this page. Note: the total cost or performance change is not necessarily the sum of the accepted VA alternatives, as there may be overlapping or synergistic effects of combining certain VA alternatives. Cost savings and cost increases are totaled separately.

VA Study Conditionally Accepted Alternatives (Page 1)

If, after the Implementation Meeting, there are conditionally accepted VA alternatives, they are listed on this page, and their information is summarized similar to the accepted VA alternatives. Note the cost and performance change associated with the conditionally accepted VA alternatives are determined with respect to the design with the VA alternatives that have already been accepted. *If there are no conditionally accepted VA alternatives, this page is deleted from the VASSR.*

VA Study Conditionally Accepted Alternatives (Page 2)

This page documents the impact of conditionally accepted alternatives on the performance rating of accepted alternatives. How much the performance rating changes for each criterion and the rationale for that change are detailed. This provides the necessary back-up to properly validate the performance change of any combination of conditionally accepted alternatives that may be accepted at a later date. In many cases, several years may pass before final disposition is made, and having this information well documented supports proper assessment and validation of performance changes. *If there are no conditionally accepted VA alternatives, this page is deleted from the VASSR.*

VA Study Benefits

This page includes information related to VA Study costs, VA alternative acceptance rate, return-on-investment calculations, and a narrative of the VA Study benefits.

The information in the VASSR is preliminary if conditionally accepted VA alternatives are noted. When the conditionally accepted VA alternatives are resolved, the VASSR will be modified to show the final results of the VA Study.

VA STUDY IDENTIFICATION & CHARTER	Caltrans
Project Name: SR 101 Roadway Stabilization	

TASK ORDER IDENTIFICATION INFORMATION

Contract	Task Order	District	County	Route	KP	EA
53A0063	204.183	1	Del Norte	101	15/15.6	01-324700

STUDY TYPE

Highway	X	**Process**		**Product**	
NHS Mandated?	X				

ANNUAL VA PROGRAM

Study listed on District VA Annual Program? (Y/N)	Y

KEY PROJECT MILESTONE DATES

M000	**Identify Need:**		**M260**	**Skeleton Layout:**	
M010	**Approve PID:**		**M380**	**Project PS&E:**	
M015	**Program Project:**		**M500**	**Approve Contract:**	
M020	**Begin Environmental:**				
M100	**Approve DPR:**		**Current WBS Activity:**		**Start Date:**
M200	**PA&ED:**				

PROJECT DESCRIPTION

The project is located in Del Norte County on Route 101, KM 24.1/25.1 (PM 15.0/15.6). This project proposes to stabilize the existing roadway situated over an active landslide area, or realign the roadway to bypass the geologically unstable portion of Route 101.

Capital Outlay Support Costs:	$0
Estimated Right of Way Cost:	$0
Estimated Project Construction Cost:	$45,000,000

PROJECT PURPOSE and NEED

This project is needed to assure that the roadway within the project study limits will remain open to vehicular traffic. This location has been identified by the District as the highest priority of all the unstable locations on this segment of Route 101. If action is not taken, further slide movement could result in closure of this portion of Route 101 with no detour available, cutting Del Norte County off from the rest of the State. The purpose of this project is to address five of nine roadway locations identified by the District Materials Engineer as showing major distress. All five locations are associated with one slide complex and would need to be addressed as one project. A commitment was made by the District to Del Norte County Transportation Commission to study and develop projects to stabilize the existing roadway.

VA STUDY PURPOSE and OBJECTIVES

Value Analyze alternatives proposed in Project Study Report. Develop other viable alternatives, preferably within the project corridor. Build consensus and resolve issues with stakeholders and transportation partners. Reduce initial cost. Reduce life-cycle costs of the project. Develop solutions to difficult transportation issues. Validate purpose and need.

VA STUDY PARTICIPANTS and SCHEDULE	Caltrans
Project Name: SR 101 Roadway Stabilization	

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VA STUDY SCHEDULE

Meeting	Dates	Times	Location
VA Study Report - Preliminary	1/1/1900 - 1/1/1900		
Pre-Study Meeting	8/14/2001 - 8/14/2001	8:00 am - 11:00 am	District 1 Room 59
VA Study Segment 1	8/21/2001 - 8/23/2001	8:00 am - 5:00 pm	District 1 Room 59
VA Study Segment 2	8/28/2001 - 8/30/2001	8:00 am - 5:00 pm	District 1 Room 59
VA Study Segment 3	9/25/2002 - 9/26/2002	9:00 am - 11:00 am	District 1, Room 59

VA STUDY PROPOSED ALTERNATIVES	Caltrans
Project Name: SR 101 Roadway Stabilization	

Summary of *Proposed* VA Alternatives

VA Alt Number	Initial Cost Savings	Subsequent Cost Savings	Highway User Cost Savings	Total LCC (NPV) Cost Savings	Change in Performance
1	$8,780,000	$0	$0	$8,780,000	20%
2	$39,030,000	$0	$0	$39,030,000	44%
3	$44,730,000	$0	$0	$44,730,000	33%

Comments

Summary of *Proposed* VA Alternatives - *Cumulative* Study Savings

VA Set Number	VA Alt Numbers	Initial Cost Savings/Cost Increase	Subsequent Cost Savings/Cost Increase	Highway User Cost Savings/Cost Increase	Total LCC (NPV) Cost Savings/Cost Increase	Change in Performance	Change in Value
1*	2	$39,030,000	$0	$0	$39,030,000	44%	996%
2	1	$8,780,000	$0	$0	$8,780,000	20%	51%

Comments

* Indicates Set Used in Report Calculations.

VA STUDY ACCEPTED ALTERNATIVES	Caltrans
Project Name: SR 101 Roadway Stabilization	

Summary of *Accepted* VA Alternatives

VA Alt Number	Initial Cost Savings	Subsequent Cost Savings	Highway User Cost Savings	Total LCC (NPV) Cost Savings	Change in Performance
2	$39,030,000	$0	$0	$39,030,000	44%

Comments

This VA Study focused on finding ways to improve value related to a severe landslide area on SR 101 in Del Norte County. The 0.6-mile project length has continually been affected by landslides caused by near-surface and deep-seated slip planes. The VA Study accepted one VA alternative that recommends installing retaining walls above and below the most active land mass and maintenance-prone areas in the project limits. The walls in these two areas would be approximately 25% of the wall length that was proposed in the VA Study base case (which was PRS Alternative 2B). The acceptance of this VA alternative resulted in a substantial value improvement of approximately 950%. The substantial initial cost savings, coupled with a performance improvement of 44%, resulted in the high value improvement. In addition to three proposed VA alternatives, the VA Study Team also developed seven "out of the VA Study Scope" alternatives that focused on ways to entirely bypass the project area. The VA Study scope was limited to the existing Caltrans right-of-way. These seven alternatives initiated requests by the National and State Parks organization to request a more in-depth analysis of several of the bypass alternatives. During the fist half of 2002, the District 1 Project Development Team further studied four of the out of scope alternatives and concluded that these were not viable because of very high costs and severe impacts to the environment and trees. Many local agencies participated in consensus building meetings during the course of the VA process. Representatives included individuals from the Del Norte County Board of Supervisors, Del Norte County Community Development, The Save the Redwoods League, the California Trucking Association, and the Friends of Del Norte County.

Summary of *Accepted* VA Alternatives - *Cumulative* Study Savings

VA Set Number	VA Alt Numbers	Initial Cost Savings/Cost Increase	Subsequent Cost Savings/Cost Increase	Highway User Cost Savings/Cost Increase	Total LCC (NPV) Cost Savings/Cost Increase	Change in Performance	Change in Value
1*	2	$39,030,000	$0	$0	$39,030,000	44%	996%

Comments

* Indicates Set Used in Report Calculations.

VA STUDY CA ALTERNATIVES (Page 2)	Caltrans
Project Name: SR 101 Roadway Stabilization	

Impact of Conditionally Accepted Alternatives on Performance Rating					
Criteria	**Criteria Weight**	**Conditionally Accepted Alternative**	**Cumulative Performance Change**	**Total Performance Adjustment**	**Rationale for Performance Change**

VA STUDY BENEFIT SUMMARY	Caltrans
Project Name: SR 101 Roadway Stabilization	

Cost of Performing VA Study (Preliminary)	
Caltrans Administrative Costs	$11,413
In-House Team Members	$24,900
Consultant Team Leader	$30,000
Consultant Team Members	$10,000
Total Study Costs	$76,313

Summary of VA Study Benefits (Preliminary)	
Accepted Implementation Rate (Accepted/with CA)	33% / 33%
Cost Reduction (Percentage Accepted/with CA)	87% / 87%
Study Return on Investment (ROI) (Accepted/with CA) Implemented Savings/Study Costs (xx:1)	511:1 / 511:1
Return of Value Improvement	12,934:1

Summary of Study Impacts

This VA Study focused on finding ways to identify ways to remedy problems related to roadbed instability on a short length (0.6 miles) of SR 101 in Del Norte County. The team identified three VA alternatives that might help reduce maintenance and keep the roadbed from sliding down a steep slope. One VA alternative was accepted: Construct Retaining Walls that Address Specific Terrain Instability. This had savings of approximately $39,000,000 compared to a base cost of $44,000,000, which proposed long lengths of retaining walls. The VA team also identified and documented several out-of-VA scope alternatives that focused on bypassing the project and tunneling around the project. These were further investigated by the Project Design Team. The results were presented to the Federal and State Parks, who agreed that the cost and severe negative environmental impacts would be great. This consensus building follow-on effort shows that VA studies can help all organizations achieve win-win results.

Value Analysis Alternatives

VA ALTERNATIVES

INTRODUCTION

The results of this study are presented as individual alternatives to the original concept. In addition, design suggestions for improving the project are included for consideration by the stakeholders.

VA ALTERNATIVES

Each alternative consists of a summary of the original concept, a description of the suggested change, a cost comparison, change in performance, a listing of its advantages and disadvantages, and a brief narrative comparing the original design with the alternative. Sketches, calculations, and benefits are also presented. The cost comparisons reflect the comparable level of detail as in the original estimate. A life cycle benefit-cost analysis for major alternatives is included where appropriate. Design suggestions are written summaries of partially developed ideas without supporting documentation.

VA SETS

VA Sets are established by the VA team as their "best value" solutions, based on improved performance, likelihood of implementation, least community impact, cost savings, or any combination of criteria. A VA Set may contain one or more alternatives, and each set is typically mutually exclusive of other sets (i.e., implementing VA Set 1 precludes implementation of VA Sets 2 and 3). VA Sets are selected alternatives combined from mutually exclusive groups that can compete in whole, or in part, against the original design concept. This requires an additional performance rating and totaling of costs for the sets.

SUMMARY OF VA ALTERNATIVES *SR 101 Roadway Stabilization*		Caltrans	
Number	**Title**	**Potential Savings**	**Performance**
1.0	Construct Retaining Walls Throughout the Project Limits	$8,780,000	+20%
2.0	Construct Retaining Walls that Only Address Specific Terrain Instability	$39,030,000	+44%
3.0	Augment the Present Maintenance Program with a Contingency Plan to Accelerate Road Damage Repairs on the Existing Alignment	$44,730,000	+33%

	Out of Right-of-Way Alternatives (Out of VA Project Scope)	**Estimated Cost**	
A	Through Cut Excavation from PM 14.5 to 15.5	$72,897,000	-9%
B.1	Simpson Land Bypass without a Tunnel	$90,000,000	+31%
B.2	Simpson Land Bypass with a Tunnel Hamilton Road Bypass	$137,000,000 $240,000,000	+19%
C.1	One Bore Two-Lane Tunnel Around Slide Area	$177,931,000	-14%
C.2	Two One-Way Tunnels Around Slide Area	$169,533,000	+2%
D	Retaining Wall with Localized Slope Stressing	$38,871,000	-19%
E	Deep Slide Stabilization with Slope Stressing	$80,000,000 to $125,000,000	-2.6

VALUE ANALYSIS ALTERNATIVE *SR 101 Roadway Stabilization*		Caltrans	
FUNCTION: Align Roadway		**IDEA NO.** AR-8	**ALTERNATIVE NO.** 1.0
TITLE: Construct Retaining Walls Throughout the Project Limits			**PAGE NO.** 1 of 6

ORIGINAL CONCEPT:

Alternative "2B" of 1995 Project Study Report. This alternative realigns the existing roadway within the study corridor, for approximately 0.6 mile. It employs some curve straightening while providing a two-lane roadway with standard shoulders. It has an alignment interior (uphill) from the present alignment, by up to 30 meters at its midpoint along the alignment. Its vertical alignment would follow approximately that of the existing roadway. "Soldier pile" tieback walls would be employed both uphill and downhill of the roadway to resist slide movement and to maintain the cuts on the uphill side made for realignment.

Solder pile tieback walls employ structural steel sections similar to H sections, placed in a drilled hole and concreted in place, spaced about two meters on center in plan view. The soldier pile usually has its lowest elevation (pile tip) selected to be below any slide plane that exists. The total length of the soldier pile is measured from its top to its tip. They are called "soldier piles", and exposed above the ground portion of the wall having lagging between the soldier piles to retain the earth; the height of a soldier pile wall is measured by the height of lagging (which is usually embedded below ground by up to three meters); that is, the distance between lowest to the highest elevation of the lagging. Tiebacks are tensile structural elements, typically steel strands, placed in a near horizontal drilled hole, grouted in place at the lowest end, tensioned in accordance with wall design requirements, and "locked" into place, thus imparting forces to resist the driving forces imposed by the retained earth. Tiebacks would be placed on the soldier pile at one or more elevations on the pile itself, depending upon the forces that need to be exerted to maintain stability.

The original concept was made without sufficient information to fully estimate the maximum wall height or length of soldier piles, but heights of up to 12 meters, and piles with lengths of 30 meters, were probably envisioned, each subject to later verification of topography and depth to slide plane, respectively.

The Geotechnical Study prepared in May, 2001, determined that this alternative was not capable of resisting forces developed by the deep-seated slide. The cost estimate for PSR Alternative 2B used for the VA study was that estimated in 1995, escalated by Caltrans cost run-up factors related to inflation.

ALTERNATIVE CONCEPT:

This is a significant revision to Alternative 2B of the 1995 PSR. This alternative suggests constructing tied back soldier pile walls on both sides of Route 101 to resist local (shallow) slope instabilities. The difference from the original concept PSR Alternative 2B would be to increase the length of the walls but decrease the tendon length, as the deeper slide plane is not being stabilized by VA Alternative 1.0.

The difference in cost relates mainly to different costs for tie back walls.

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 44,966,000	$ 0	$ 0	$ 44,966,000
Alternative Concept	$ 36,186,000	$ 0	$ 0	$ 36,186,000
Savings	$ 8,780,000	$ 0	$ 0	$ 8,780,000

Team Member: Dan Adams	**Discipline:** Structural	**PERFORMANCE:** +20%

VALUE ANALYSIS ALTERNATIVE *SR 101 Roadway Stabilization*	Caltrans	
TITLE: Construct Retaining Walls Throughout the Project Limits	**ALTERNATIVE NO.** 1.0	**PAGE NO** 2 of 6

ADVANTAGES:

- Construction and traffic control will not be on an emergency contract; therefore, the impact on the public should be less
- Stays mainly within existing right-of-way
- Improves roadway geometrics
- Protects against the shallower slip outs

DISADVANTAGES:

- May not help keep the highway open in the event of slippage in the deep slide plane

DISCUSSION / JUSTIFICATION:

By installing relatively small walls on both sides of the highway for the whole length of this project, roadway geometrics could be improved while stabilizing the slope. Stabilization on the deep slippage plane will not be increased.

Maintenance movements of one-half inch per year are considered chronic.

TECHNICAL REVIEWER COMMENTS:

Design – Would this alternative reduce the likelihood of a catastrophic failure? Reply: It would not stop a catastrophic event. A three-foot roadway drop associated with some earthquake events might be repaired in three days.

Design – Does this provide long-term stability? Reply: Probably not; however, it has not been studied at this time.

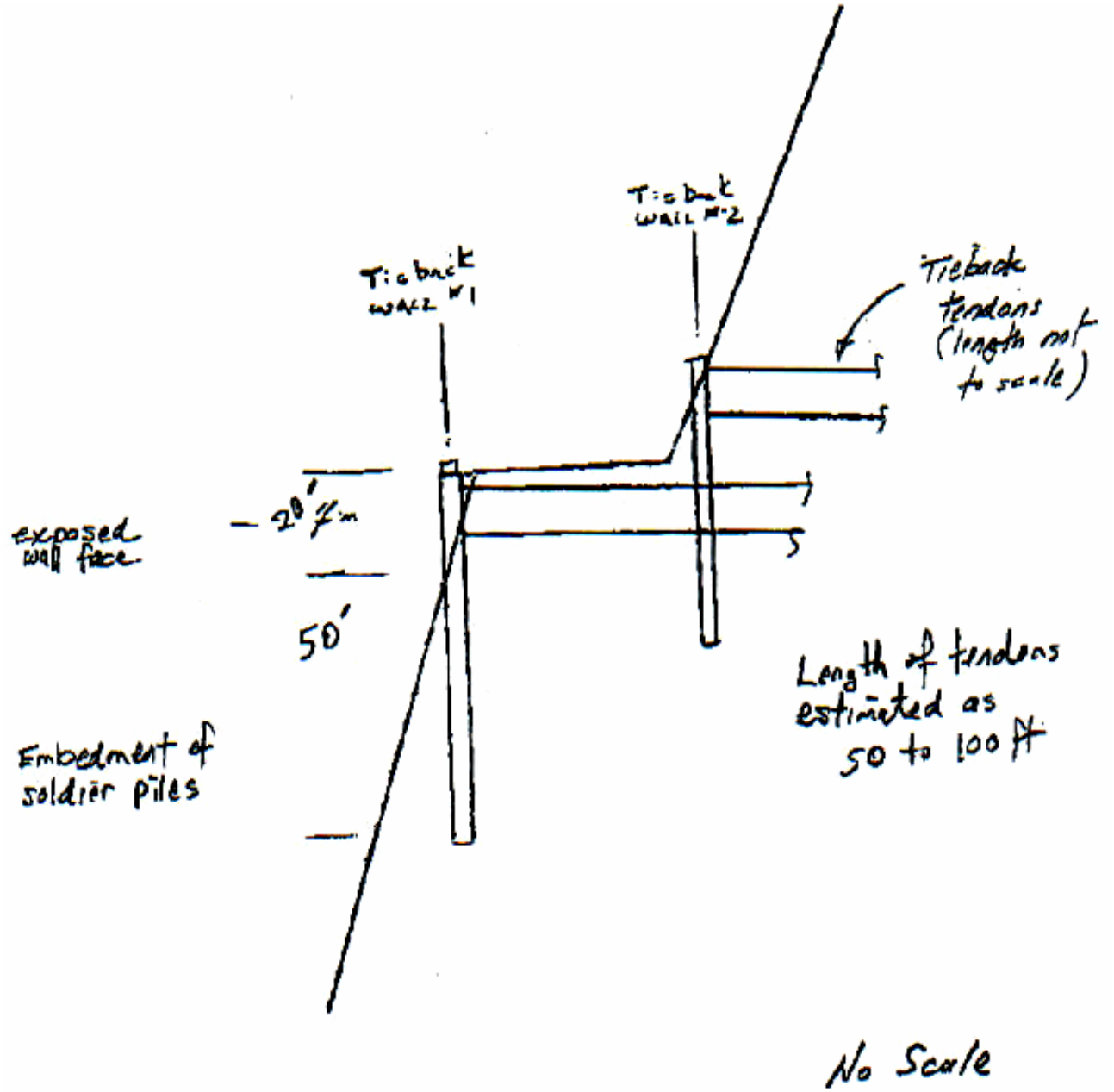
Design – How far would these walls go down? Reply: Probably as much as 50 feet.

Maintenance – The H piles in the above-ground exposed part of the walls would have some exposure to salt and therefore some corrosion. There would be massive walls to maintain, and access to the structures for repairs would be necessary.

IMPLEMENTATION CONSIDERATIONS:

Repairs and replacements of wall would be expected in the future, since this VA alternative is not a solution that will permanently stabilize the deep-seated slide.

SKETCHES *SR 101 Roadway Stabilization*	Caltrans	
TITLE: Construct Retaining Walls Throughout the Project Limits	**NUMBER** 1.0	**PAGE NO.** 3 of 6



Tieback Wall #2: Length = 962 m Height average = 6 m = 20 ft

Tieback Wall #1: Length = 720 m Height average = 6 m = 20 ft

Length: Measured along roadway Height: Exposed face of wall

PERFORMANCE MEASURES *SR 101 Roadway Stabilization*		Caltrans	
TITLE: Construct Retaining Walls Throughout the Project Limits		**NUMBER** 1.0	**PAGE NO.** 4 of 6
CRITERIA	**Performance**	**Original**	**Alternative**
Right-of-Way: The realignment will require ~1 acre take of the park.	Measure	Degree	Degree
	Rating	4	5
	Weight	29	29
	Contribution	116	145
Maintainability: Except for stability on the deep slide, maintainability will be essentially the same.	Measure	Degree	Degree
	Rating	6	6
	Weight	24	24
	Contribution	144	144
Environmental Impact: Considerably less impact on trees.	Measure	Degree	Degree
	Rating	3	6
	Weight	17	17
	Contribution	51	102
Aesthetics:	Measure	Degree	Degree
	Rating	6	5
	Weight	12	12
	Contribution	72	60
Roadway Geometrics: Increased roadway width.	Measure	Degree	Degree
	Rating	7	8
	Weight	9	9
	Contribution	63	72
Constructibility: One-way traffic during construction.	Measure	Days	Days
	Rating	2	4
	Weight	9	9
	Contribution	18	36
Total Performance:		**464**	**559**
Net Change in Performance:			**+20%**

Assumption

Tieback Wall Cost = \$2,000 m^2

Wall #1 = 720 m x 6 m x \$2,000/m^2 = \$8,640,000

Wall #2 = 962 m x 6 m x \$2,000/m^2 = \$11,544,000

The assumed height was taken as six meters (from the as-built drawings), and the length was assumed to be the whole length of the project (0.6 miles) on both sides of the highway; subtracting the 98-meter long and 48-meter long walls that already exist.

INITIAL COSTS
SR 101 Roadway Stabilization

Caltrans

TITLE
Construct Retaining Walls Throughout the Project Limits

NUMBER 1.0

PAGE NO. 6 of 6

CONSTRUCTION ELEMENT	ORIGINAL CONCEPT				ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Roadway Excavation	M^3	36,000	$15	$540,000	36,000	$15	$540,000
Traffic Control System	LS	1	$2,000,000	$2,000,000	1	$2,000,000	$2,000,000
Class 1 Aggregate Subbase	M^3	4,600	$25	$115,000	4,600	$30	$138,000
Class 2 Aggregate Base	M^3	1,900	$35	$66,500	2,000	$40	$80,000
Asphalt Concrete	tonne	3,900	$60	$234,000	3,900	$60	$234,000
Other roadway items (drainage, clear/grub, etc.)	LS	1	$95,000	$95,000	1	$124,000	$124,000
10% Mobilization	ea	1	$0	$0	1	$311,600	$311,600
ROADWAY SUBTOTAL				*$3,050,500*			*$3,427,600*
ROADWAY MARK-UP	*35%*			*$1,067,675*			*$1,199,660*
VA ADDED MARK-UP				*$10,000*			*$10,000*
ROADWAY TOTAL				*$4,128,175*			*$4,637,260*
STRUCTURE ITEMS							
Tieback Walls	LS	1	$26,400,000	$26,400,000	1	$20,200,000	$20,200,000
10% Mobilization	ea	1	$2,640,000	$2,640,000	1	$2,020,000	$2,020,000
STRUCTURE SUBTOTAL				*$29,040,000*			*$22,220,000*
STRUCTURE MARK-UP	*25%*			*$7,260,000*			*$5,555,000*
VA ADDED MARK-UP							
STRUCTURE TOTAL				*$36,300,000*			*$27,775,000*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition		1	$370,000	$370,000	1	$384,000	$384,000
Utility Relocation							
Relocation Assistance							
Demolition							
Title and Escrow Fees							
RIGHT-OF-WAY TOTAL				*$370,000*			*$384,000*
ENVIRONMENTAL MITIGATION ITEMS							
		1	$80,000	$80,000	1	$100,000	$100,000
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign	0.1			$4,087,818			$3,289,626
Project Engineering							
TOTAL				$44,965,993			$36,185,886
TOTAL (Rounded)				$44,966,000			$36,186,000
						SAVINGS	$8,780,000

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Construct Retaining Walls Throughout the Project Limits	**NUMBER** 1.0

Team Member: Dan Adams

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Mike Eagan

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Gary Garofalo

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Deborah Harmon

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Jackson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Construct Retaining Walls Throughout the Project Limits	**NUMBER** 1.0

Team Member: Jon Kaneshiro

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Susan Morrison

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Aida Parkinson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Stapleton

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VA ALTERNATIVE IMPLEMENTATION ACTION *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Construct Retaining Walls Throughout the Project Length	**NUMBER** 1.0
RESPONSES	**DISPOSITION**
Technical Feasibility / Validated Performance: This VA alternative is technically feasible; however, it is rejected in favor of VA Alternative 2.0 because it is more cost effective, has less negative environmental impacts, and will be easier to program than the project base case.	☐ **Accept** ☐ **Conditionally Accept** ☑ **Reject**
Implementable Portions:	**Validated Performance** %
Validated Cost Savings:	**Validated Savings**
Schedule Impacts:	
Other Comments: If geotechnical studies conducted during the Project Development Process determine that VA Alternative 2.0 cannot be implemented, then this VA alternative may become an option to potentially resolve slope instability concerns.	

VALUE ANALYSIS ALTERNATIVE *SR 101 Roadway Stabilization*		Caltrans	
FUNCTION: Increase Stability		**IDEA NO.** IS-17	**ALTERNATIVE NO.** 2.0
TITLE: Construct Retaining Walls that Only Address Specific Terrain Instability			**PAGE NO.** 1 of 11

ORIGINAL CONCEPT:

Use soldier pile tieback walls above and below the roadway (Alternative "2B" of the 1995 PSR).

ALTERNATIVE CONCEPT:

This VA alternative would retain the existing alignment. This VA alternative addresses only the most unstable areas of this project. This VA alternative proposes to construct maintenance tieback soldier pile walls below the roadway to resist lateral shallow slope instabilities in areas of poorly consolidated materials with transverse and longitudinal cut-off drainage structures. Soil nail walls will be used along the slopes above the roadway to retain slide mass. Ditches above and behind the wall crest would capture upslope surface runoff and cross drains would convey the water downslope. This proposal is about one-third the length of the original concept proposal. This VA alternative differs from VA Alternative 1.0 in that the upslope treatment is soil nail walls instead of soldier pile tiebacks and is approximately 25% of the length.

ADVANTAGES:

- Lowest initial cost alternative
- Maintains existing scenic corridor viewshed
- Minimizes right-of-way acquisition – tieback and slope maintenance easements only
- Minimizes tree removal
- Relative ease of constructibility
- Short lead time to permit, fund, and construct
- Geometrics regarding shoulder width and superelevation can be improved
- Prevent slip-out resulting from sliding along the shallower slip planes

DISADVANTAGES:

- Two construction seasons traffic is reduced to signalized one-way traffic
- Geometrics are not appreciably improved – speed, passing lanes, etc.
- Does not stabilize deep landslide or catastrophic events

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 44,966,000	$ 0	$ 0	$ 44,966,000
Alternative Concept	$ 5,936,000	$ 0	$ 0	$ 5,936,000
Savings	$ 39,030,000	$ 0	$ 0	$ 39,030,000

Team Member: Doug Jackson	**Discipline:** Structures Construction	**PERFORMANCE:** +44 %

DISCUSSION / JUSTIFICATION:

This alternative intends to retain upslope slide debris, collecting upslope surface and subsurface run-off, and conveying to a lower slope area, potentially improving roadway width/superelevations, and retaining/stabilizing existing roadway fill areas.

This alternative is justified based upon maximizing the VA performance measures established for this value analysis: minimize expanding right-of-way into park boundaries, improve maintainability by increasing stability, minimize environmental impacts, maintain aesthetics of the existing viewshed, remain within existing highway corridor to qualify as a SHOPP project, and select construction methods pragmatic to physical characteristics of the VA study area. In addition, ease of permitting due to similar projects having been completed in the vicinity of VA study area, ease of funding due to lower cost, and reduction of traffic accidents due to rock slides, and improved geometrics.

TECHNICAL REVIEWER COMMENTS:

Design – Does this alternative work when the roadway is slipping entirely? Reply: No, it is only good for localized stability.

Design – When this alternative is compared to Alternative 1, does it increase stability? Reply: It is probably not much different.

Structures Construction – Does this have one row of tieback walls, not both above and below? Reply: There could be two to three levels of tiebacks on the wall. The wall would be placed adjacent to the downhill side.

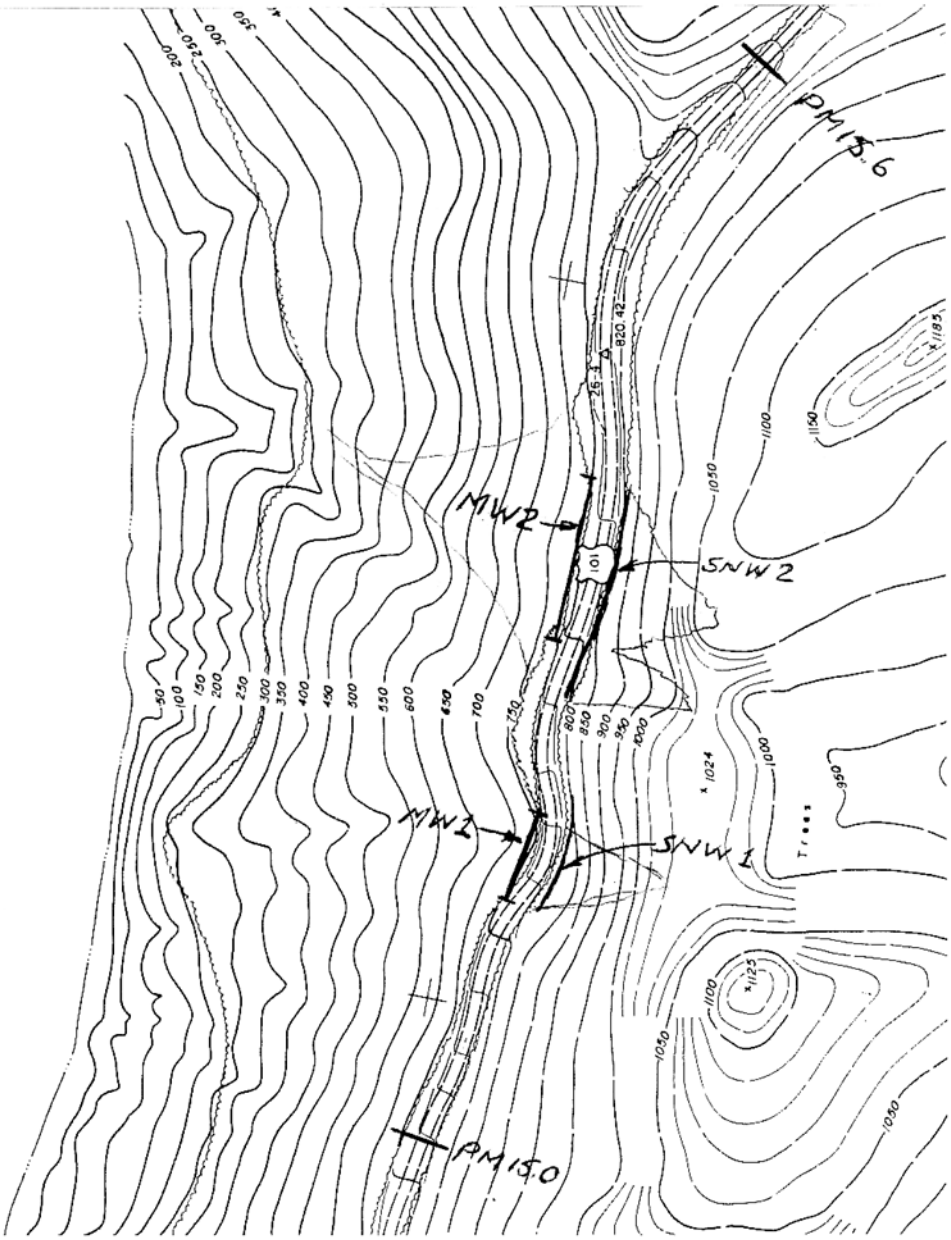
IMPLEMENTATION CONSIDERATIONS:

Observational method instrumentation and monitoring would be needed to determine where walls would be placed.

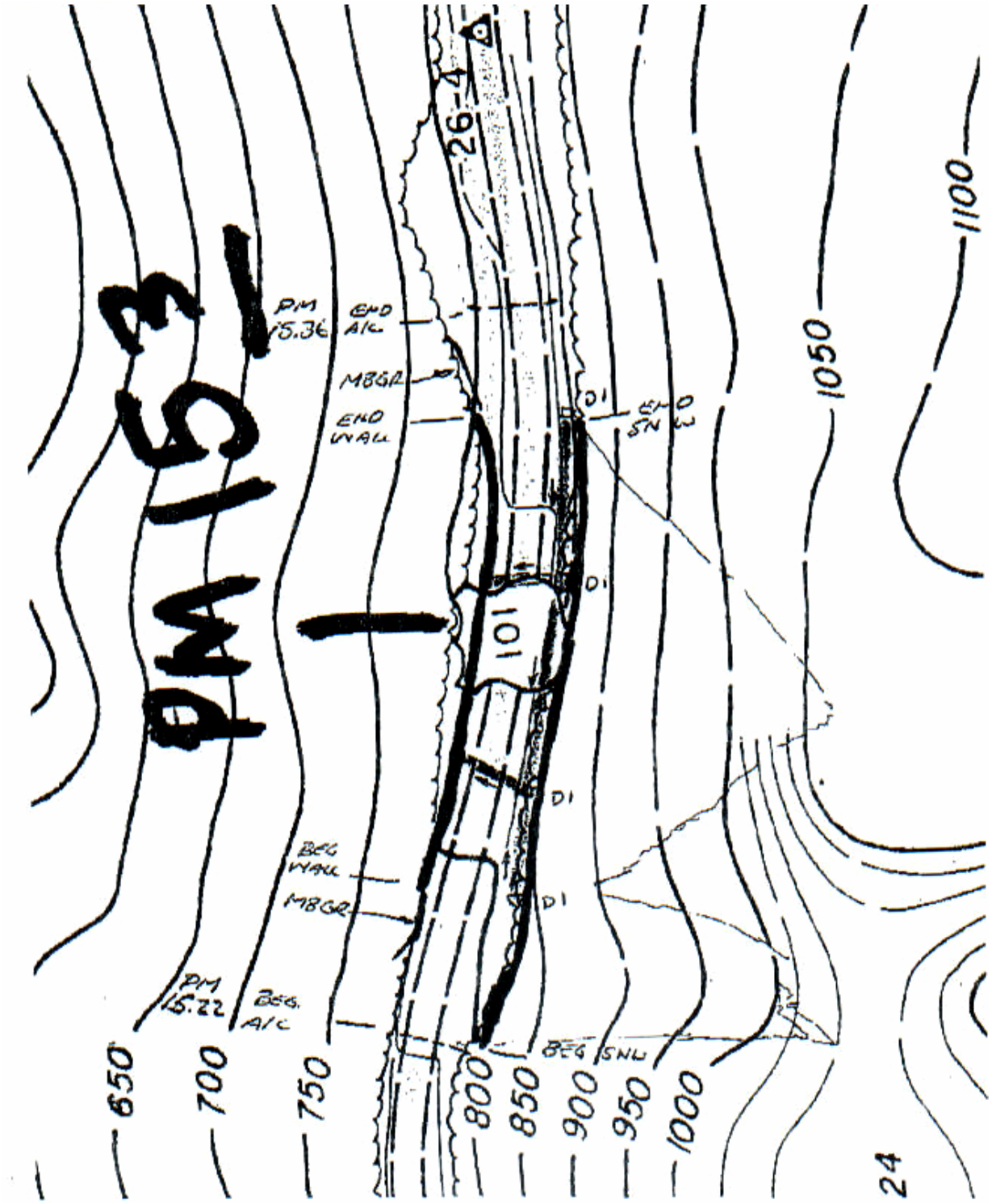
Considerable layout, geotechnical, and environmental information would have to be obtained.

Some locations will require walls higher than 6 meters, while other locations will not require any walls.

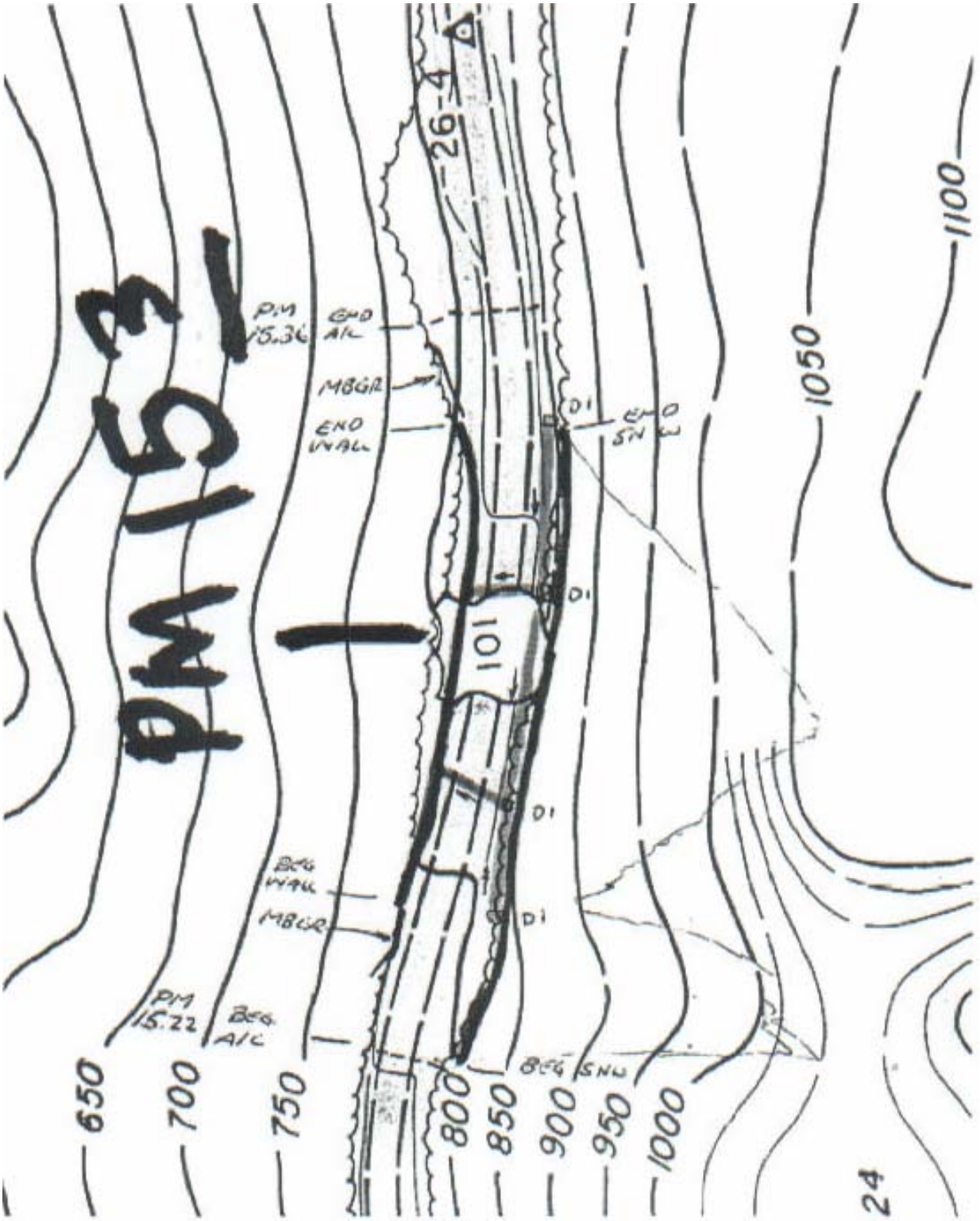
Repairs and replacements of wall would be expected in the future since this VA alternative is not a solution that will permanently stabilize the deep-seated slide.



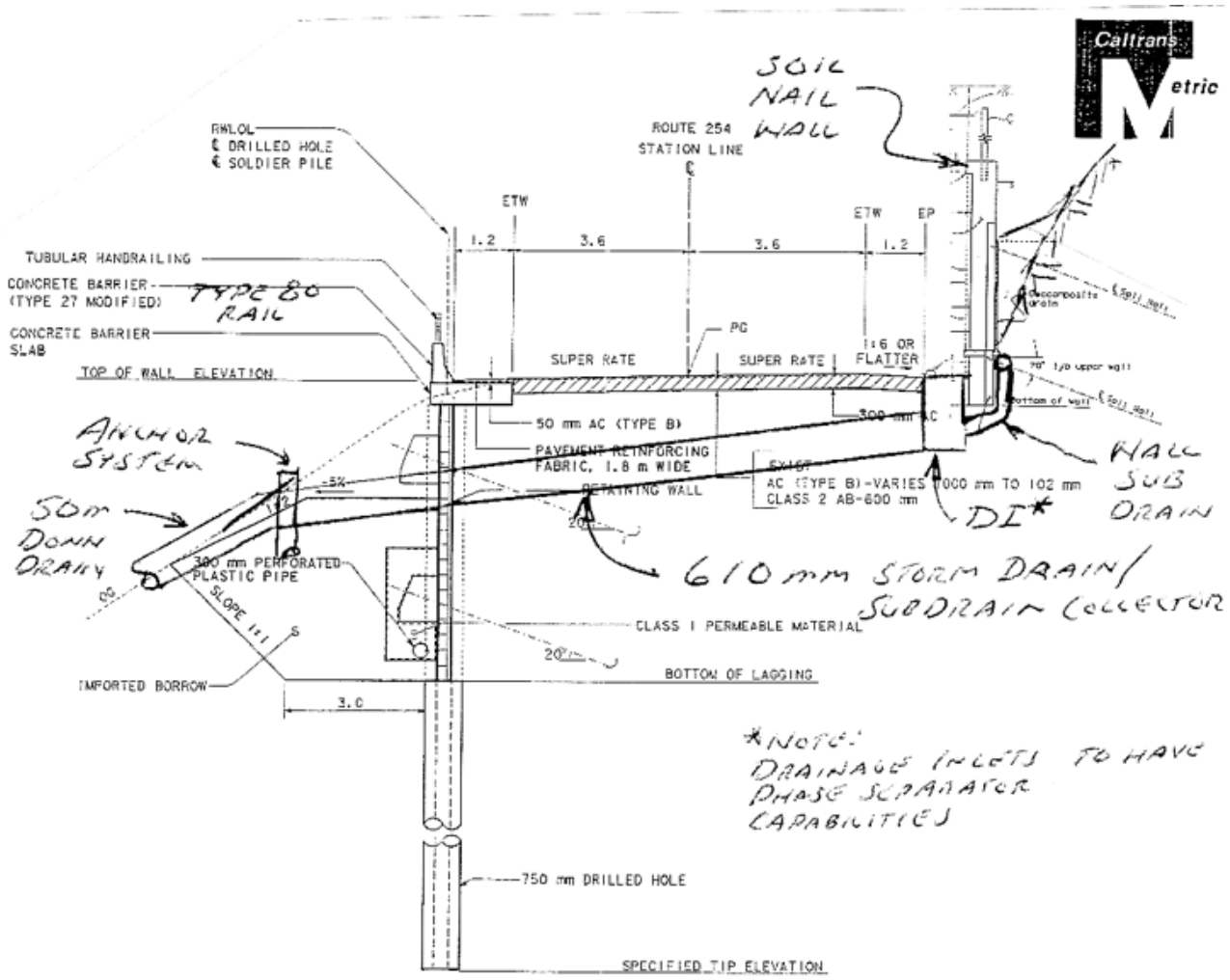
Plan



Maintenance Wall No. 1
PM 15.12 to 15.20



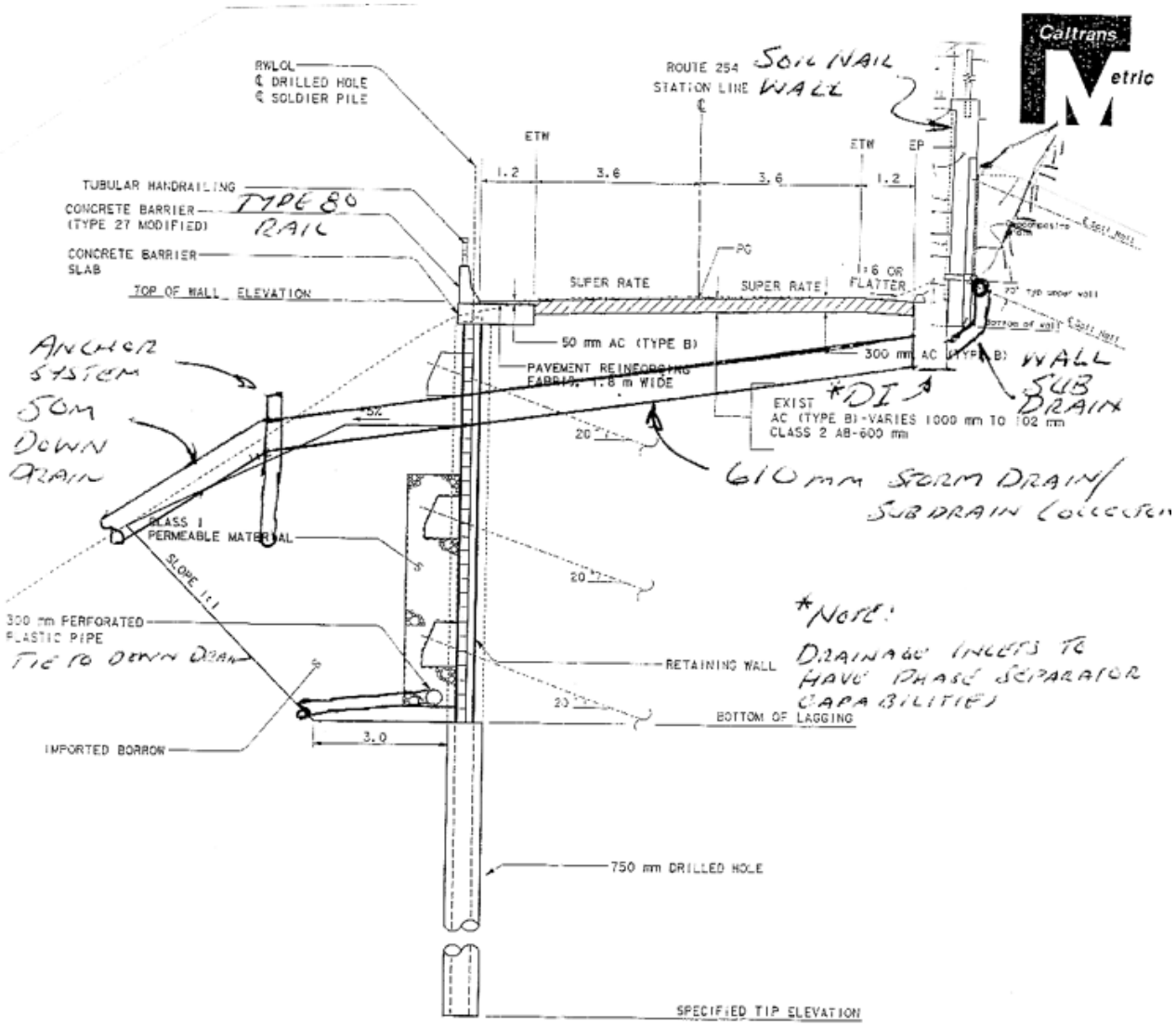
Maintenance Wall No. 2
PM 15.22 to 15.36



Typical Section

Location 1

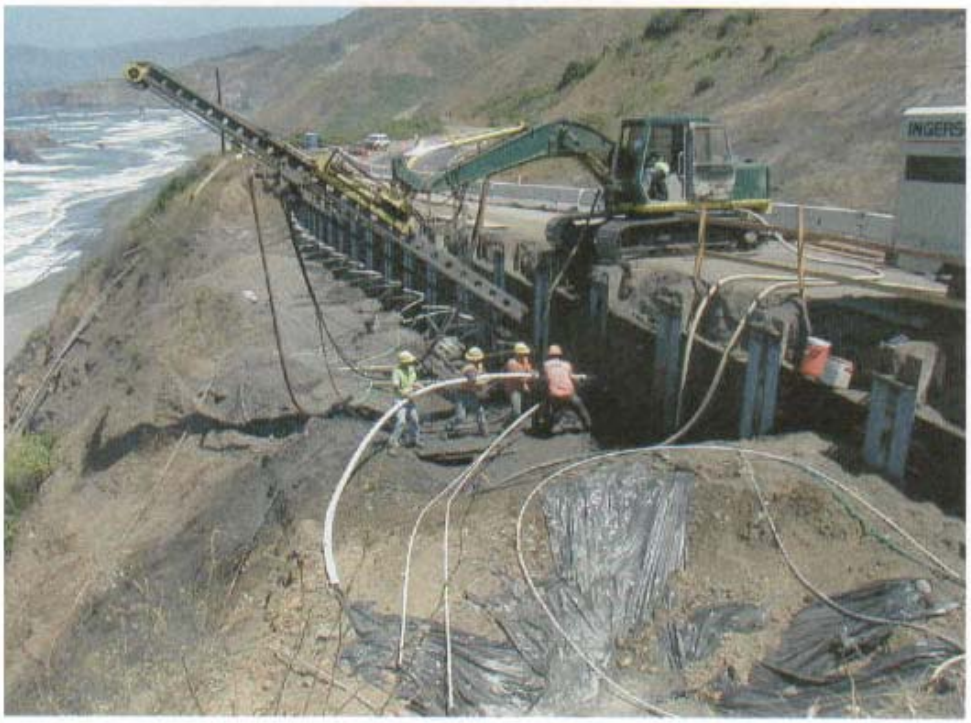
(MN1/SNW1)

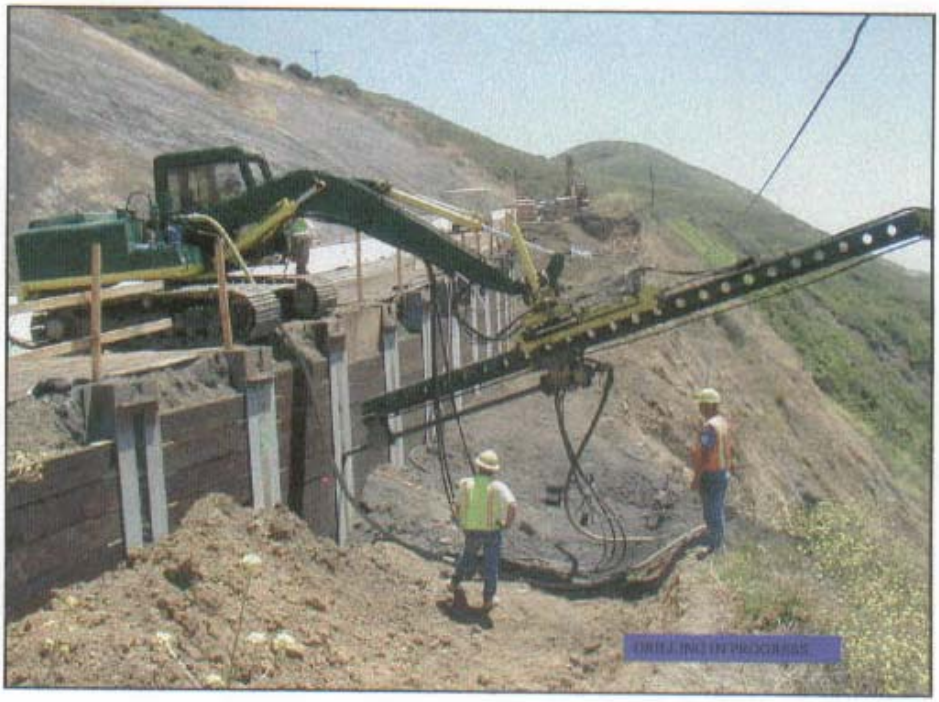


Typical Section

Location 2

(MN2/SNW2)





TYPICAL CONSTRUCTION METHODS

PERFORMANCE MEASURES *SR 101 Roadway Stabilization*		Caltrans	
TITLE:	Construct Retaining Walls that Only Address Specific Terrain Instability	**NUMBER** 2.0	**PAGE NO.** 9 of 11

CRITERIA	Performance	Original	Alternative
Right-of-Way: No of right-of-way takes, with the exception of slope easements and tieback/soil nail subsurface easements.	Measure	Degree	Degree
	Rating	4	8
	Weight	29	29
	Contribution	116	232
Maintainability: Temporary road width reductions to clear/repair slides will be needed.	Measure	Degree	Degree
	Rating	6	5
	Weight	24	24
	Contribution	144	120
Environmental Impact: Minimal impact as a result of maintaining project within existing right-of-way.	Measure	Degree	Degree
	Rating	3	9
	Weight	17	17
	Contribution	51	153
Aesthetics: Existing viewsheds, ocean views maintained – upslope tieback walls may be architecturally enhanced.	Measure	Degree	Degree
	Rating	6	6
	Weight	12	12
	Contribution	72	72
Roadway Geometrics: No improvements in alignment. Slight improvement in width to allow a bike lane in shoulder area.	Measure	Degree	Degree
	Rating	7	6
	Weight	9	9
	Contribution	63	54
Constructibility: One-way traffic (at least during soil nail work) may allow for reduced width two-lane traffic during tieback installations.	Measure	Days	Days
	Rating	2	4
	Weight	9	9
	Contribution	18	36
Total Performance:		**464**	**667**
Net Change in Performance:			**+44%**

Tieback Wall Cost Estimates

198 m wall S/O VA study area - \$2,000 k → \$10.1 k/m

48 m wall N/O VA study area - \$580 k → \$12.1 k/m

Soil Nail Wall Cost Estimates

Broadway wall – 2,230 m^2 wall @ \$1.446 k → \$648/m^2 3 m avg. height

Mall wall – 254 m^2 wall @ \$182 k → \$717/m^2 use \$2 k/linear meter

INITIAL COSTS
SR 101 Roadway Stabilization

Caltrans

TITLE
Construct Retaining Walls that Only Address Specific Terrain Instability

NUMBER 2.0 | **PAGE NO.** 11 of 11

CONSTRUCTION ELEMENT	ORIGINAL CONCEPT				ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Roadway Excavation	M^3	36,000	$15	$540,000	1	$5,000	$5,000
Traffic Control System	LS	1	$2,000,000	$2,000,000	1	$150,000	$150,000
Class 1 Aggregate Sub base	M^3	4,600	$25	$115,000			
Class 2 Aggregate Base	M^3	1,900	$35	$66,500	343	$35	$12,005
Asphalt Concrete	tonne	3,900	$60	$234,000	1,346	$60	$80,760
Other roadway items (drainage, clear/grub, etc.)	LS	1	$95,000	$95,000	1	$153,000	$153,000
10% Mobilization	ea	1	$0	$0	1	$40,000	$40,000
ROADWAY SUBTOTAL				*$3,050,500*			*$440,765*
ROADWAY MARK-UP	*35%*			*$1,067,675*			*$154,268*
VA ADDED MARK-UP				*$10,000*			*$10,000*
ROADWAY TOTAL				*$4,128,175*			*$605,033*
STRUCTURE ITEMS							
Tieback Walls	LS	1	$26,400,000	$26,400,000	250	$10,000	$2,500,000
Soil Nail Walls	M	1	$2,640,000	$2,640,000	292	$2,000	$584,000
Type 80 Rail	M				250	$1,600	$400,000
10% Mobilization	ea				1	$348,000	$348,000
STRUCTURE SUBTOTAL				*$29,040,000*			*$3,832,000*
STRUCTURE MARK-UP	*25%*			*$7,260,000*			*$958,000*
VA ADDED MARK-UP							
STRUCTURE TOTAL				*$36,300,000*			*$4,790,000*
Supplemental Funds				$69,000			$15,000
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition		1	$370,000	$370,000	1	$384,000	$384,000
Utility Relocation							
Relocation Assistance							
Demolition							
Title and Escrow Fees							
RIGHT-OF-WAY TOTAL				*$370,000*			*$0*
ENVIRONMENTAL MITIGATION ITEMS							
		1	$80,000	$80,000			$0
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign	0.1			$4,087,818			$541,000
Project Engineering							
TOTAL				$44,965,993			$5,936,033
TOTAL (Rounded)				$44,966,000			$5,936,000
						SAVINGS	$39,030,000

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Construct Retaining Walls that Only Address Specific Terrain Instability	**NUMBER** 2.0

Team Member: Dan Adams

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Mike Eagan

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Gary Garofalo

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Team Member: Deborah Harmon

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Team Member: Doug Jackson

☑ I have reviewed this alternative and agree with it as it is written
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VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Construct Retaining Walls that Only Address Specific Terrain Instability	**NUMBER** 2.0

Team Member: Jon Kaneshiro

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Susan Morrison

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Aida Parkinson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Stapleton

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VA ALTERNATIVE IMPLEMENTATION ACTION *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Construct Retaining Walls that Only Address Specific Terrain Instability	**NUMBER** 2.0
RESPONSES	**DISPOSITION**
Technical Feasibility / Validated Performance: Although this is not a complete fix to the instability problems in the project area, it is acceptable to State and National Parks.	☑ **Accept** ☐ **Conditionally Accept** ☐ **Reject**
Implementable Portions: A complete fix would stabilize the deep-seated slip plane which is unrealistic to physically construct because of slope steepness and inability to penetrate stable ground with conventional stabilizing methods.	**Validated Performance** 44%
Validated Cost Savings:	**Validated Savings** $39,030,000
Schedule Impacts: This VA alternative would be easier to program that the proposed base; therefore, there is a potential for earlier project delivery.	
Other Comments: In the event that any geologic studies conducted during the Project Development Stage conclude that this VA alternative is infeasible, then VA Alternative 1.0 may become an option.	

VALUE ANALYSIS ALTERNATIVE *SR 101 Roadway Stabilization*		Caltrans	
FUNCTION:	Maintain Highway	**IDEA NO.** C-5	**ALTERNATIVE NO.** 3.0
TITLE:	Augment the Present Maintenance Program with a Contingency Plan to Accelerate Road Damage Repairs on the Existing Alignment		**PAGE NO.** 1 of 8

ORIGINAL CONCEPT:

Use soldier pile tieback walls above and below the roadway (Alternative "2B" of the 1995 PSR).

ALTERNATIVE CONCEPT:

No build and keep present maintenance program. Under this alternative, the subject section of SR 101 would continue to be maintained under the existing maintenance/construction strategy at a cost of approximately $640,000 per year for the 12.5 to 15.6 PM segment. The maintenance cost is approximately $60,000 per year for maintenance and construction of one tieback wall every five years in the 15.0 to 15.6 PM segment. In addition, a contingency plan would be developed that would address a "catastrophic" failure event. One example contingency plan is included in the Assumptions and Calculations section of this VA Alternative for reference. It is intended as a starting point for discussion; it is not a final contingency plan.

This example contingency plan assumes reconstruction of the existing alignment using a soldier pile tieback wall design. The plan would include advance material procurement and storage. Thus, material would be ready for use at a standby location in the event of a "catastrophic" failure. Contractor services would be acquired according to existing emergency contracting procedures.

ADVANTAGES:

- Clarifies Caltrans plan for responding in an emergency—the result is lessened concern from interested parties regarding potential Caltrans action in an emergency
- Minimizes immediate environmental impacts when compared to other VA Alternatives
- Eliminates immediate right-of-way acquisition
- Eliminates immediate degradation of aesthetics
- Increases ability to respond swiftly and efficiently in an emergency situation
- Minimizes time to reopen roadway in an emergency
- Provides a mechanism for early contact with stakeholders
- Might allow for advance 4(f) clearance as necessary
- Consistent with Redwood National State Park Management Plan dated 4/6/2000 – specifically its circulation/roads section, pp 61-62
- Might be funded out of existing SHOPP program with relative ease
- Contingency plan would be implemented only when absolutely necessary – in the event of catastrophic failure
- Minimizes material procurement costs
- Delays costly construction that is not currently necessary
- Would avoid difficult transportation of large H beams on roads with considerable curves in an emergency

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 44,966,000	$ 0	$ 0	$ 44,966,000
Alternative Concept	$ 236,000	$ 0	$ 0	$ 236,000
Savings	$ 44,730,000	$ 0	$ 0	$ 44,730,000

Team Member:	Susan Morrison Dan Adams	**Discipline:**	Transportation & Structures	**PERFORMANCE:**	**+33 %**

DISADVANTAGES:

- Provides no long-term solution to impacts of continuous earth movement – intermittent road closures
- Roadway geometrics are not improved
- Less flexibility to minimize potential environmental impacts
- May require expenditure of funds to procure and store materials before they are needed
- Purchase of material that may not be usable, depending upon the failure
- Potential overdesign related to placing a bigger H beam that is needed
- Potential for design of a solution that may never be implemented
- May require some administrative costs

DISCUSSION / JUSTIFICATION:

The subject section of SR 101, known as the Last Chance Grade, sits on a steep cliff with the Pacific Ocean to the west, and a highly unstable hillside with multiple slide planes both north and east of the roadway. The area has been the subject of intensive study since at least 1987, because of concerns that serious roadway failures might cut off Del Norte county from the rest of California to the south. During reconstruction related to roadway settlement, Del Norte County's primary population centers would be isolated from the remainder of California, with access only from the north via SR 101 and SR 199 into Oregon.

This alternative gives heavy emphasis to minimizing impacts to the environment, aesthetics, and right-of-way takes, while at the same time addressing the fact that a serious roadway failure may occur. In addition, it allows early consultation and dialogue with stakeholders.

Geotechnical experts suggest that two types of catastrophic failure events are possible in the project area. One is caused by a major earthquake and the other by significant rainfall; either of these events could cause an estimated 3 to 10 feet of movement by activating the deep-seated failure plane. These effects would likely be major disruption of vehicular traffic, including a full roadway closure of at least one to two weeks.

This alternative specifically addresses the possibility of either of these failure events by developing a contingency plan that would be ready for implementation when such a failure occurred. This example plan assumes the use of soldier pile tieback walls as the key component of hillside stabilization and roadway reconstruction. It will provide an opportunity to have a supply of construction material on hand to repair damage. It would not necessarily provide enough material for a complete repair.

The potential difficulty of procuring H-sections quickly in an emergency situation means that purchasing them in advance, as part of a contingency plan is essential. Because steel manufacturers generally produce H-sections in interval batches, a scarcity of H-sections could significantly slow the construction and roadway reopening.

Under this alternative soldier pile tieback walls could be designed using H-sections of specific size. A three-week supply of these H-sections would be procured and stored for immediate use in the event of a catastrophic failure. Without these stored materials, the project could be delayed by as much as three weeks. This delay translates into prolonged roadway closures and lack of access to the northern part of Del Norte County.

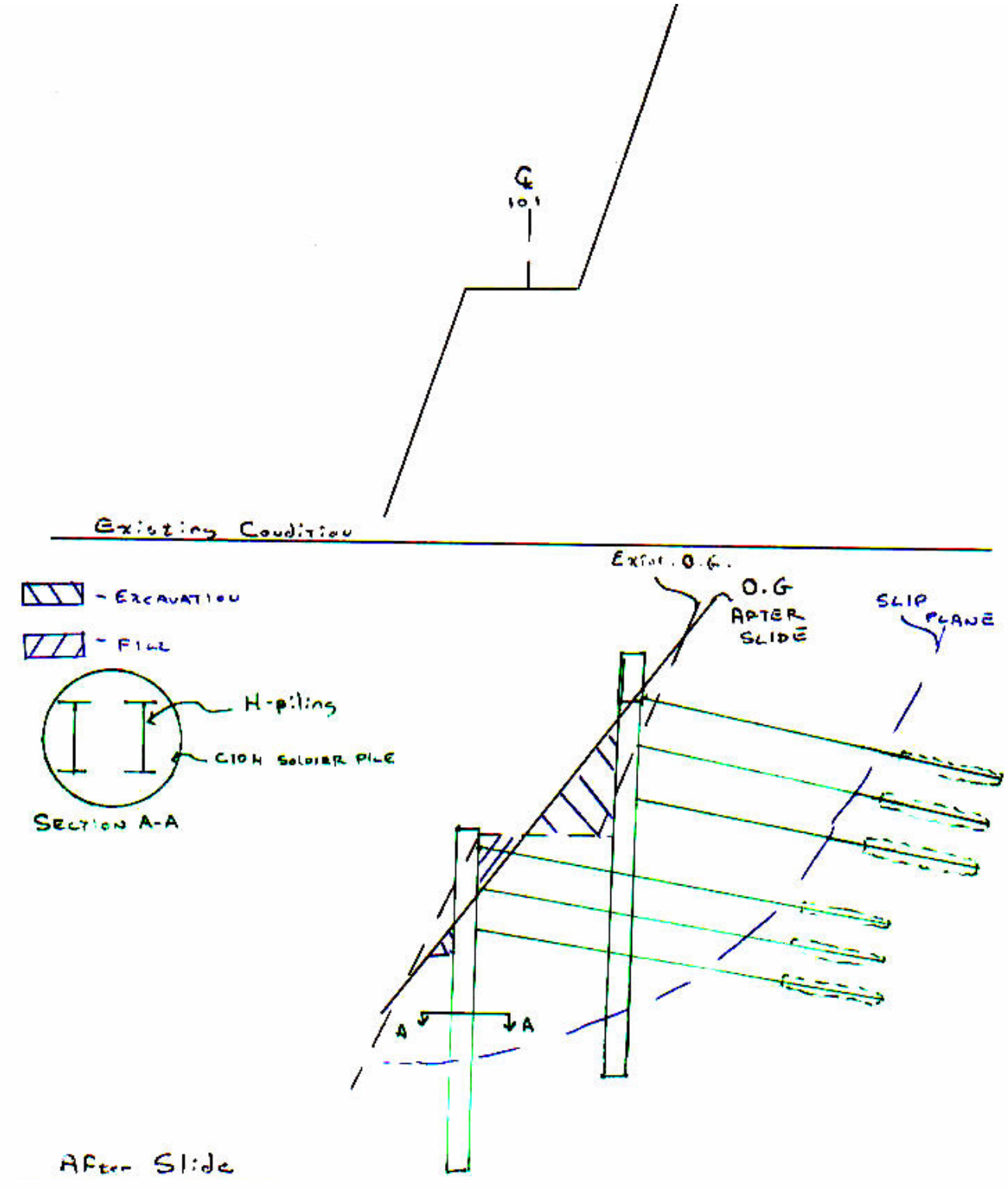
TECHNICAL REVIEWER COMMENTS:

IMPLEMENTATION CONSIDERATIONS:

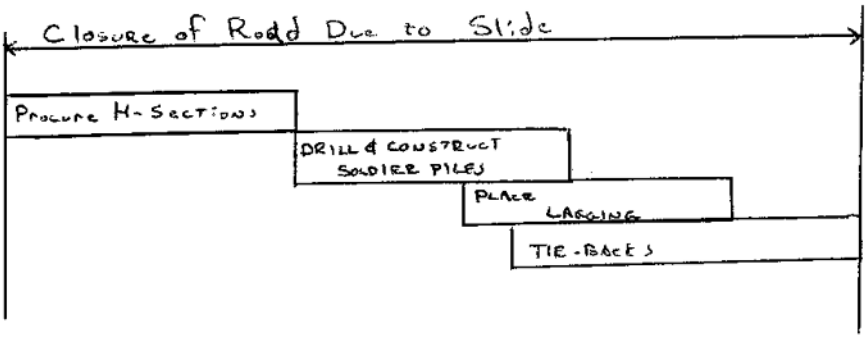
A contingency plan should be developed and periodically programmed into the project funding process. It should address different types of expected traffic disruptions. Responsibilities should be identified and assigned. Integration with routine roadway projects should be considered.

Maintenance – The acquisition of lagging material has been difficult in the past.

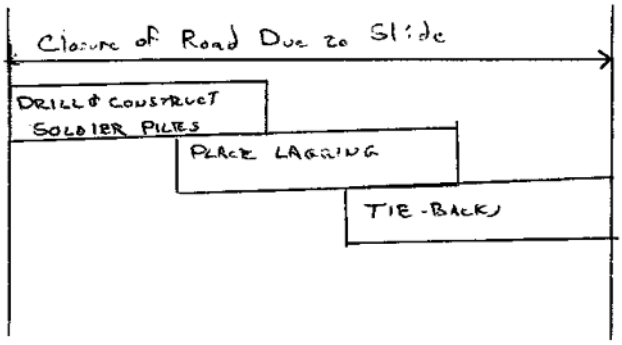
Suggest meetings with external stakeholders to resolve potential issues and concerns.


℄
101
Existing Condition
Exist. O.G.
O.G
AFTER
SLIDE
SLIP
PLANE
- EXCAVATION
- FILL
H-piling
CIOH SOLDIER PILE
SECTION A-A
A
A
After Slide

EXAMPLE



Critical Path w/o Procuring H-Sections



Critical Path if H-Sections are procured.

PERFORMANCE MEASURES *SR 101 Roadway Stabilization*		Caltrans	
TITLE:	Augment the Present Maintenance Program with a Contingency Plan to Accelerate Road Damage Repairs on the Existing Alignment	**NUMBER** 3.0	**PAGE NO.** 6 of 8

CRITERIA	Performance	Original	Alternative
Right-of-Way: Would not require significant right-of-way from the base case alternative.	Measure	Degree	Degree
	Rating	4	8
	Weight	29	29
	Contribution	116	232
Maintainability: A reduction over the base case alternative because road stabilizing improvements are not made.	Measure	Degree	Degree
	Rating	6	3
	Weight	24	24
	Contribution	144	72
Environmental Impact: This VA alternative proposes essentially a no-build, which causes much less environmental impacts.	Measure	Degree	Degree
	Rating	3	8
	Weight	17	17
	Contribution	51	136
Aesthetics:	Measure	Degree	Degree
	Rating	6	5
	Weight	12	12
	Contribution	72	60
Roadway Geometrics: No improvement to roadway geometrics.	Measure	Degree	Degree
	Rating	7	3
	Weight	9	9
	Contribution	63	27
Constructibility: Construction would not take place unless a catastrophic failure occurred. If failure occurred, constructibility would be better than no-build.	Measure	Days	Days
	Rating	2	10
	Weight	9	9
	Contribution	18	90
Total Performance:		**464**	**617**
Net Change in Performance:			**+33%**

- Annual cost to sustain current maintenance/construction = $700,000.
- Continuation of current maintenance/construction strategy on current alignment and within Caltrans right-of-way.
- Contingency plan construction would be implemented only under defined "catastrophic" failure: (1) 2"-12" or (2) 3'.
- Storage at Redwood National/State Park "Sand House" facility.
- Need enough stored piles to be ahead of steel manufacturing process by three weeks.
- Not planning for other materials, labor, etc., because steel is the key to moving forward swiftly in an emergency.
- Soldier pile tieback walls on the current alignment would be an adequate design solution under a catastrophic failure event.

Soldier Pile Spacing = 3 m

Soldier Pile Length = 15 m

NOTE: Procure enough H-section piling to get a three-week head start.
Assume three piles can be constructed/day.

$$\frac{3 \text{ piles}}{\text{day}} \times 2 \text{ H-sections/pile} \times \frac{15 \text{ m}}{\text{pile}} \times 21 \text{ days} = 1{,}890 \text{ LM (H-section)}$$

$$1{,}890 \text{ LM} \times \frac{\$100}{\text{LM}} = \underline{\$189{,}000 \sim \$200{,}000}$$

Procuring the H-sections could reduce the road closure by as much as 21 days.

Procure contracts (Contract Administration Maintenance).

Renew every 5 years.

This will add an annual administration cost to administer contracts.

INITIAL COSTS
SR 101 Roadway Stabilization

Caltrans

TITLE
Augment the Present Maintenance Program with a Contingency Plan to Accelerate Road Damage Repairs on the Existing Alignment

NUMBER	PAGE NO.
3.0	8 of 8

CONSTRUCTION ELEMENT		ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Roadway Excavation	M^3	36,000	$15	$540,000			$0
Traffic Control System	LS	1	$2,000,000	$2,000,000			$0
Class 1 Aggregate Sub base	M^3	4,600	$25	$115,000			$0
Class 2 Aggregate Base	M^3	1,900	$35	$66,500			$0
Asphalt Concrete	tonne	3,900	$60	$234,000			$0
Other roadway items(drainage, clear/grub, etc)	LS	1	$95,000	$95,000			$0
10% Mobilization	ea	1	$0	$0			$0
ROADWAY SUBTOTAL				*$3,050,500*			*$0*
ROADWAY MARK-UP	*35%*			*$1,067,675*			*$0*
VA ADDED MARK-UP				*$10,000*			*$0*
ROADWAY TOTAL				*$4,128,175*			*$0*
STRUCTURE ITEMS							
Tieback Walls	LS	1	$26,400,000	$26,400,000			$0
10% Mobilization	ea	1	$2,640,000	$2,640,000			$0
Furnish H-Sections	M				1,890	$100	$189,000
STRUCTURE SUBTOTAL				*$29,040,000*			*$189,000*
STRUCTURE MARK-UP	*25%*			*$7,260,000*			*$47,250*
VA ADDED MARK-UP				*$0*			*$0*
STRUCTURE TOTAL				*$36,300,000*			*$236,250*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition		1	$370,000	$370,000			$0
Utility Relocation							
Relocation Assistance							
Demolition							
Title and Escrow Fees							
RIGHT-OF-WAY TOTAL				*$370,000*			*$0*
ENVIRONMENTAL MITIGATION ITEMS							
		1	$80,000	$80,000			$0
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign	0.1			$4,087,818			$0
Project Engineering							
TOTAL				$44,965,993			$236,250
TOTAL (Rounded)				$44,966,000			$236,000
						SAVINGS	$44,730,000

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*		**Caltrans**
TITLE:	Augment the Present Maintenance Program with a Contingency Plan to Accelerate Road Damage Repairs on the Existing Alignment	**NUMBER** 3.0

Team Member: Dan Adams

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Mike Eagan

☑ I have reviewed this alternative and agree with it as it is written
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Team Member: Gary Garofalo

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Team Member: Deborah Harmon

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Team Member: Doug Jackson

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VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*		Caltrans
TITLE:	Augment the Present Maintenance Program with a Contingency Plan to Accelerate Road Damage Repairs on the Existing Alignment	**NUMBER** 3.0

Team Member: Jon Kaneshiro

☑ I have reviewed this alternative and agree with it as it is written
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Team Member: Susan Morrison

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Aida Parkinson

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☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Stapleton

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☐ I have reviewed this alternative and suggest the following (or attached) changes

VA ALTERNATIVE IMPLEMENTATION ACTION *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Augment the Present Maintenance Program with a Contingency Plan to Accelerate Road Damage Repairs on the Existing Alignment	**NUMBER** 3.0
RESPONSES	**DISPOSITION**
Technical Feasibility / Validated Performance: This VA alternative is technically feasible; however, the project decision makers agreed that the contingency plan concept be forwarded to the District Maintenance organization as a best management practice to be applied to the project area.	☐ **Accept** ☐ **Conditionally Accept** ☑ **Reject**
Implementable Portions:	**Validated Performance** %
Validated Cost Savings:	**Validated Savings** $
Schedule Impacts:	
Other Comments:	

VALUE ANALYSIS ALTERNATIVE *SR 101 Roadway Stabilization*		Caltrans	
FUNCTION: Align Roadway		**IDEA NO.** AR-1	**ALTERNATIVE NO.** A
TITLE: Through Cut Excavation from PM 14.5 to 15.5			**PAGE NO.** 1 of 6

ORIGINAL CONCEPT:

PSR Alternate 2B

Deep-seated soldier pile walls.

ALTERNATIVE CONCEPT:

This alternative would realign SR 101 in a through-cut to the east of the slide plane of the Last Chance Slide. The proposed alignment would be approximately 1,600 meters (1 mile) in length. Soldier pile walls will be required at the south and north to tie ends to the existing alignment. This alternative would generate a minimum of 2,900,000 m^3 of disposal material, require a minimum 10.28 hectares (2540 acres) of right-of-way from Del Norte Coast Redwoods State Park, impact an estimated minimum of 275 old growth redwood trees, and cost $68,000,000.

ADVANTAGES:

- Built on stable ground
- Increases ocean retreat buffer
- Can be built with conventional equipment and techniques
- Provides more opportunities for vista points
- Minimizes closures and delays during construction

DISADVANTAGES:

- Removes up to 275 old growth redwoods
- Requires highly threatened and endangered species mitigation costs
- Significant disposal issues and costs
- Requires significant parkland
- Requires two years minimum to construct

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 44,966,000	$ 0	$ 0	$ 44,966,000
Alternative Concept	$ 72,897,000	$ 0	$ 0	$ 72,897,000
Savings	$ (27,931,000)	$ 0	$ 0	$ (27,931,000)

Team Member: Michael Stapleton	**Discipline:** Engineering	**PERFORMANCE:** - 9%

DISCUSSION / JUSTIFICATION:

This alternative was one of the four alternatives evaluated by the 1995 PSR. Of the four alternatives, this alternative was the only one determined to be geotechnically feasible in the May 2001 Preliminary Geotechnical Report. The deep excavation would be devastating to this portion of Del Norte Coast Redwood State Park and would require a very significant disposal site. If a catastrophic slide did occur with mass wasting of the slope into the ocean, this alternative could be started under a contingency plan to reopen the roadway. Funding for soldier pile walls for the beginning and ending tie ends for the excavation have been included. Traffic would be impacted less than other alternatives proposed on the existing alignment by the VA study. Extending the original PSR extent from approximately ½ mile to 1 mile in length would tie the south end into more stable ground.

TECHNICAL REVIEWER COMMENTS:

Design – How long to do this? Reply: About five to seven years to complete.

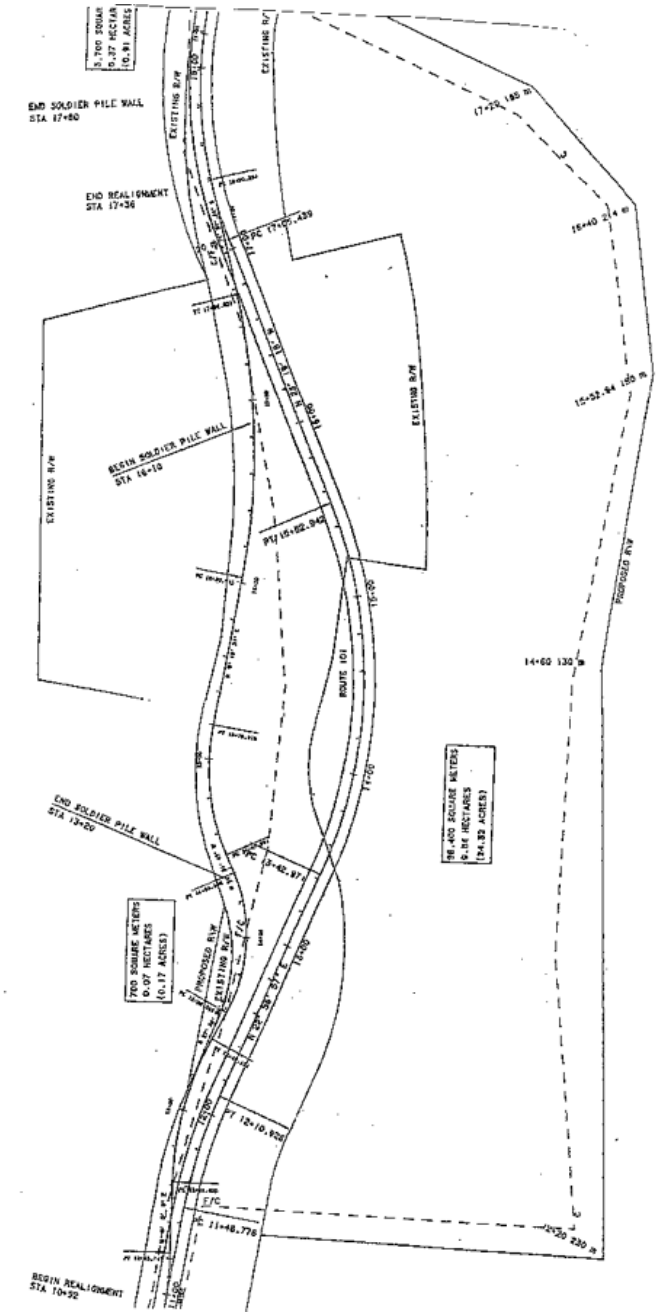
The time to implement could be condensed. Trees are a main issue related to this alternative.

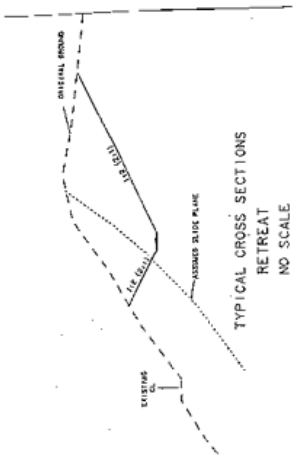
IMPLEMENTATION CONSIDERATIONS:

Additional geotechnical investigations would be required to determine the exact location of the slide slip plane. Extensive environment mitigation will be required for damage to the State Park. Disposal areas are becoming difficult to find.

Implementation would be hindered by resistance from some organizations.

SKETCHES ***SR 101 Roadway Stabilization***	**Caltrans**	
TITLE: Through Cut Excavation from PM 14.5 to 15.5	**NUMBER** A	**PAGE NO.** 3 of 6





PERFORMANCE MEASURES *SR 101 Roadway Stabilization*		Caltrans	
TITLE: Through Cut Excavation from PM 14.5 to 15.5		**NUMBER** A	**PAGE NO.** 4 of 6
CRITERIA	**Performance**	**Original**	**Alternative**
Right-of-Way Through cut will severely impact this portion of Del Norte Coast Redwoods State Park.	Measure	Degree	Degree
	Rating	4	1
	Weight	29	29
	Contribution	116	29
Maintainability Realigning the roadway behind the major slide plane will greatly increase stability.	Measure	Degree	Degree
	Rating	6	8
	Weight	24	24
	Contribution	144	192
Environmental Impact A minimum of 275 old growth redwoods may be removed by this alternative.	Measure	Degree	Degree
	Rating	3	1
	Weight	17	17
	Contribution	51	17
Aesthetics View of the ocean may be reduced, but opportunities for vista points and a trail on the existing alignment may be available.	Measure	Degree	Degree
	Rating	6	4
	Weight	12	12
	Contribution	72	48
Roadway Geometrics Improve curve radii to current standards with occasional turnouts. Existing alignment is available for non-motorized use of the corridor.	Measure	Degree	Degree
	Rating	7	8
	Weight	9	9
	Contribution	63	72
Constructibility Conventional construction, with only major impacts at tie-in to existing alignment. Long-distance disposal of excavated material will slow construction.	Measure	Days	Days
	Rating	2	7
	Weight	9	9
	Contribution	18	63
Total Performance:		**464**	**421**
Net Change in Performance:			**-9%**

ASSUMPTIONS & CALCULATIONS *SR 101 Roadway Stabilization*	Caltrans	
TITLE: Through Cut Excavation from PM 14.5 to15.5	**NUMBER** A	**PAGE NO.** 5 of 6

1. Item quantities from 1995 PSR rounded up.
2. Item costs from 1995 PSR escalated by 1.34 factor (5%/year for 6 years).
3. Portable, changeable, message signage added.
4. Traffic and drainage items increased using engineering judgment.
5. Funds for partnering, value analysis, and Dispute Review Board added to estimate.
6. 10% mobilization and 25% contingency added to roadway and structure subtotals.
7. Right-of-way costs escalated by 1.34 factor.
8. Environmental mitigation costs escalated by 1.34 factor.
9. Capital outlay support costs 10% of roadway and structure subtotals.
10. Original PSR quantities for PM 15.0/15.6, but this alternative is for PM 14.5/15.5, which could theoretically double quantities. However, it is felt that $68,000,000 should be sufficient to build one mile of two-lane roadway.

INITIAL COSTS
SR 101 Roadway Stabilization

Caltrans

TITLE
Through Cut Excavation from PM 14.5/15.5

NUMBER A

PAGE NO. 6 of 6

CONSTRUCTION ELEMENT	ORIGINAL CONCEPT				ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Roadway Excavation	M^3	36,000	$15	$540,000	2,900,000	$12	$34,800,000
Traffic Control System	LS	1	$2,000,000	$2,000,000	1	$1,809,500	$1,809,500
Class 1 Aggregate Sub base	M^3	4,600	$25	$115,000	4,600	$25	$115,000
Class 2 Aggregate Base	M^3	1,900	$35	$66,500	2,000	$35	$70,000
Asphalt Concrete	tonne	3,900	$60	$234,000	4,000	$60	$240,000
Other roadway items (drainage, clear/grub, etc)	LS	1	$95,000	$95,000	1	$965,000	$965,000
10% Mobilization	ea	1	$0	$0	1	$3,799,950	$3,799,950
ROADWAY SUBTOTAL				*$3,050,500*			*$41,799,450*
ROADWAY MARK-UP	*35%*			*$1,067,675*			*$14,629,808*
VA ADDED MARK-UP				*$10,000*			*$10,000*
ROADWAY TOTAL				*$4,128,175*			*$56,439,258*
STRUCTURE ITEMS							
Tieback Walls	LS	1	$26,400,000	$26,400,000	1	$3,180,000	$3,180,000
10% Mobilization	ea	1	$2,640,000	$2,640,000	1	$318,000	$318,000
STRUCTURE SUBTOTAL				*$29,040,000*			*$3,498,000*
STRUCTURE MARK-UP	*25%*			*$7,260,000*			*$874,500*
VA ADDED MARK-UP							
STRUCTURE TOTAL				*$36,300,000*			*$4,372,500*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition		1	$370,000	$370,000	1	$384,000	$384,000
Utility Relocation							
Relocation Assistance							
Demolition							
Title and Escrow Fees							
RIGHT-OF-WAY TOTAL				*$370,000*	*1*	*$6,236,360*	*$6,236,360*
ENVIRONMENTAL MITIGATION ITEMS							
		1	$80,000	$80,000	1	$1,701,800	$1,701,800
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign	0.1			$4,087,818			$4,147,053
Project Engineering							
TOTAL				$44,965,993			$72,896,971
TOTAL (Rounded)				$44,966,000			$72,897,000
						SAVINGS	($27,931,000)

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Through Cut Excavation from PM 14.5 to 15.5	**NUMBER** A

Team Member: Dan Adams

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Mike Eagan

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Gary Garofalo

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Deborah Harmon

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Jackson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Through Cut Excavation from PM 14.5 to 15.5	**NUMBER** A

Team Member: Jon Kaneshiro

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Susan Morrison

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Aida Parkinson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Stapleton

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ANALYSIS ALTERNATIVE *SR 101 Roadway Stabilization*		Caltrans	
FUNCTION: Align Roadway		**IDEA NO.** AR-3, 15, 23	**ALTERNATIVE NO.** B.1
TITLE: Simpson Land Bypass without Tunnel			**PAGE NO.** 1 of 8

ORIGINAL CONCEPT:

Minor roadway realignment and stabilization with soldier pile tieback walls above and below the road. This is alternative 2B in the February 1995 PSR.

ALTERNATIVE CONCEPT:

These alternatives address the long-term stability problem by completely bypassing the landslide complex with a horizontal alignment to the east of the distressed slope area. There are two basic alignments proposed, one of which has two variations. The alternatives are a Simpson Bypass with and without a tunnel, and a Hamilton Road Bypass. Both alignments begin at the Wilson Creek Bridge at PM 12.5. The shorter of the two alignments, called the Simpson Bypass because it traverses private lands owned by Simpson Timber, rejoins the existing highway at PM 16.3. This realignment has two variations for the northerly terminus at PM 16.3. One variation rejoins the existing alignment across the surface of parkland through old growth forest, and the other variation uses a tunnel to pass beneath parkland to reduce impacts to old growth forest. The second proposed alignment is about 12 miles in length and rejoins the existing alignment at Hamilton Road, around PM 22.5. This alignment, called the Hamilton Road alignment, traverses parklands primarily at the northern end, but it completely bypasses old growth forest. Bypass alternatives would allow the highway to be constructed on more stable ground, which would reduce traffic interruptions and delays from road failure and subsequent repairs. This would reduce long-term recurring maintenance costs.

Three bypass variations on two different alignments are proposed. All variations have a southerly terminus at the mouth of Wilson Creek (PM 12.5). The Simpson Bypass would be similar to the Alternative R alignment, as depicted on the Wilson Creeks Bluff Bypass in the 1994 Corridor Study (Alternative E in the 1987 PSR). This alignment has a northerly terminus at PM 16.3; this is one of the shortest feasible bypass alignments, but it still requires right-of-way through old growth forest in Del Norte Coast Redwoods State Park. A variation of this alternative includes a tunnel at the northern terminus as a way of minimizing the take of old growth trees. This alternative includes a half-mile long tunnel that would require the take of approximately six old growth trees within the Caltrans right-of-way for the construction of its northern portal.

This alternative, Simpson Land Bypass without a Tunnel (and variations), would construct a new two-lane alignment to the east of the present roadway, with the intent of avoiding or minimizing impacts to parklands, especially old growth forest.

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	**$** $44,966,00	**$** 0	**$** 0	**$** $44,966,00
Alternative Concept	**$** $90,000,00	**$** 0	**$** 0	**$** $90,000,00
Savings	**$** ($45,034,000)	**$** 0	**$** 0	**$** ($45,034,000)

Team Member:	Aida Parkinson Doug Jackson	**Discipline:**	Environmental Structures Construction	**PERFORMANCE:**	**+31%**

ALTERNATIVE CONCEPT (Continued):

This alternative does not meet the project's original constraint to stay within the Caltrans alignment and right-of-way. It would require right-of-way from private landowners and parks. However, this alternative is considered because it is a long-term solution to the slope instability, which could be constructed close to modern highway standards, and it would have fewer impacts to park resources than realignment within or close to the existing right-of-way.

This alternative would allow the new highway to be constructed to a 50-mph design speed. The existing alignment would be relinquished to the parks for park users.

The Hamilton Road Bypass would attempt to avoid old growth forest by establishing a route through previously harvested timberlands, some of which are now within park boundaries. This route would be substantially longer, and it would join existing alignments at PM 12.5 at Wilson Creek and PM 22.5 at Hamilton Road.

ADVANTAGES:

- Long-term solution to stability problem
- Minimizes or avoids impacts to old growth trees
- Bypasses known major slide planes
- Reduces long-term recurring maintenance costs
- Reduces traffic delays and interruptions from repairs and major maintenance projects
- Building on stable grounds avoids potential for catastrophic failure that would result in long-term traffic delays and interruptions
- Road would be constructed with favorable geometrics
- Constructed with conventional methods, with potential for balanced cut and fill
- Road would presumably have improved maintainability if constructed on stable ground
- Retaining existing alignment would allow traffic flow without major construction delays during project construction
- Possible re-use of existing alignment for park purposes
- Maintains historic elements of existing highway that make it eligible for listing on the National Register

DISADVANTAGES:

- Does not meet purpose and need of SHOPP project
- Requires substantial project funding
- Might require legislation to establish a demonstration project, like Prairie Creek Bypass, in order to obtain necessary funding.
- Requires right-of-way from private landowners and/or parks
- The short bypass (Simpson) without a tunnel would adversely affect more old growth trees and endangered species that are old-growth dependent, but it is less costly than a longer bypass (Hamilton Road) that does not affect old growth forest
- Stormwater management measures are likely to be expensive due to the amount of new ground disturbance

DISCUSSION / JUSTIFICATION:

Bypass alternatives may be one of the few technically feasible long-term engineering solutions to the stability problem posed by the current alignment. The bypass options would minimize, if not eliminate, road closures due to slides. A bypass could be constructed with conventional techniques and would allow traffic flow on the existing alignment during bypass construction. Recurring maintenance and repair costs for the existing alignment would be reduced, but substantial project funding would be required. Funding for the SR 101 bypass around Prairie Creek Redwoods State Park was obtained through legislation for a demonstration project.

It is not possible to determine the timing or extent of a catastrophic road failure. In the event of a widespread catastrophic failure that might occur in a large subduction earthquake or major winter storm that produces widespread flooding and road failures, emergency funding might be available. However, this cannot be assumed for project planning purposes. Re-opening a route following catastrophic road failure might require weeks, which would create significant problems for Del Norte County and travelers and businesses located in southwestern Oregon and northwestern California. The proposed bypass alternatives avoid the problems associated with road closures of long duration, as well as the shorter delays and interruptions associated with maintenance and repair of the existing road. A bypass would be designed with wider shoulders than the current alignment. Wider shoulders would accommodate bicyclists and would substantially improve bicyclist safety. Alternatively, bicyclists could use the current alignment, which would have less through traffic and probably no commercial traffic.

Environmental groups and park agencies have consistently requested that Caltrans study bypass options as a long-term solution to avoid impacts to parklands from repairs required by slope failures on the existing alignment, and from highway improvements needed to accommodate modern transportation. Bypass alternatives all require some park right-of-way, because parklands extend in a strip along the coast between Klamath and Crescent City. However, some parklands, mostly in the National Park but also east of the Alder Campground on Mill Creek in Del Norte Coast Redwoods State Park, have been previously harvested, so that an alignment might be planned that avoids or minimizes impacts to old growth trees.

Impacts to old growth trees would be difficult to mitigate through purchase of private tracts of old growth, because there is very little old growth redwood forest remaining in private ownership.

The existing highway alignment is eligible for listing on the National Register of Historic Places. Bypassing the current alignment would retain the historic character of the existing highway. Continual repairs to the existing highway over the long term might adversely affect the historic character.

A bypass would not feature the ocean views available on the current alignment. However, constructing a bypass offers the opportunity to create a world-class travel experience, which is one of the goals in the 2000 Redwood National and State Parks General Management Plan/General Plan.

The shorter (Simpson) bypass would improve the experience of hikers on the California Coastal Trail, because these hikers would not have to cross through the traffic on the existing highway around post mile 15.7. The Hamilton Road Bypass offers the opportunity to provide a pedestrian highway crossing that would connect the Coastal Trail with the Inland Trail systems in Redwood National and State Parks and Smith River NRA.

Performance measures were not computed for the Hamilton Road Bypass because this project is currently infeasible from an economic and political standpoint due to its length and required right-of-way. A rough estimate of the cost of this option would be $240,000,000.

TECHNICAL REVIEWER COMMENTS:

Right-of-Way: Some right-of-way will be required, and it would be very difficult to acquire.

Friends of Del Norte County: How long will it take to be built? Reply: The key is money for building the road, which is uncertain; it could be SHOPP or it could be STIP.

Friends of Del Norte County: Were the significant impacts to Wilson Creek considered? Reply: Yes. Items such as avoiding the slide plane and park impacts were considered.

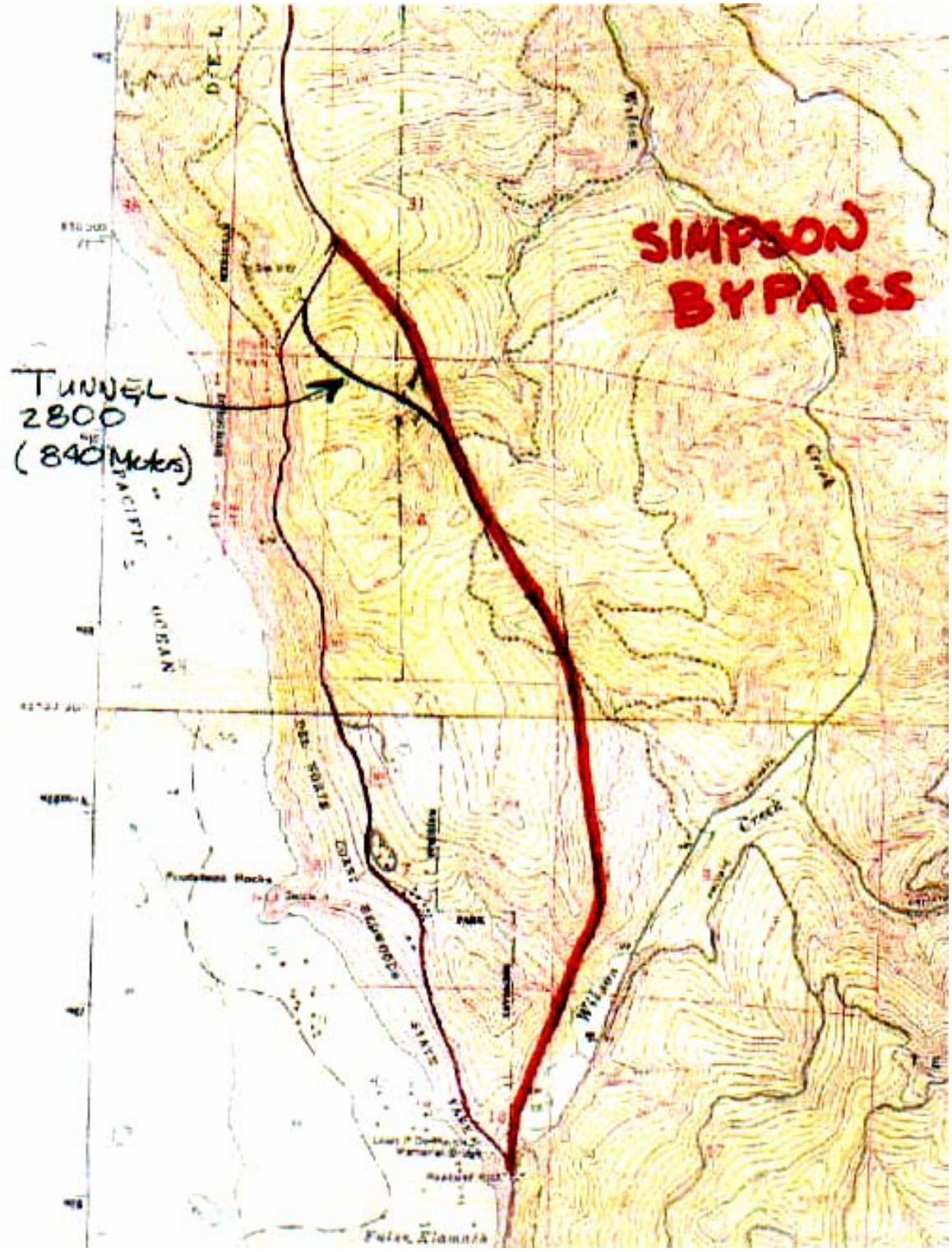
IMPLEMENTATION CONSIDERATIONS:

Right-of-way take from Simpson would be politically difficult. Any right-of-way take inside or outside the parks would probably require legislation, because neither the park agencies nor the private landowners would willingly relinquish right-of-way. Obtaining right-of-way for the Highway 101 bypass around Prairie Creek Redwoods State Park required condemnation. Legislation would also be likely to obtain funding for construction of this as a demonstration project, because the costs are significantly greater than could be funded out of Caltrans District 1 typical funding.

Any impacts to old growth trees would be opposed by environmental groups and park agencies. The two shorter bypass alternatives that re-join the highway at post mile 16.3 require some take of old growth trees, although the tunnel would affect fewer trees.

May require Legislative action to acquire right-of-way.

SKETCHES *SR 101 Roadway Stabilization*	Caltrans	
TITLE: Simpson Land Bypass without Tunnel	**NUMBER** B.1	**PAGE NO.** 5 of 8



Copied from 1994 SR 101 Corridor Study (based on 1987 Wilson Creek bypass proposals) showing bypass

PERFORMANCE MEASURES ***SR 101 Roadway Stabilization***		**Caltrans**	
TITLE: Simpson Land Bypass without Tunnel		**NUMBER** B.1	**PAGE NO.** 6 of 8
CRITERIA	**Performance**	**Original**	**Alternative**
Right-of-Way: Requires take of parklands for right-of-way.	Measure	Degree	Degree
	Rating	4	3
	Weight	29	29
	Contribution	116	87
Maintainability: This is a new facility that avoids known unstable areas altogether.	Measure	Degree	Degree
	Rating	6	10
	Weight	24	24
	Contribution	144	240
Environmental Impact: This alternative requires substantial tree takes, including some old growth redwoods at PM 16.3 where the bypass rejoins the current alignment. There will also be substantial impact to threatened and endangered species from impacts to both old growth trees and to large second growth trees that meet the definition of suitable habitat for owls.	Measure	Degree	Degree
	Rating	3	3
	Weight	17	17
	Contribution	51	51
Aesthetics:	Measure	Degree	Degree
	Rating	6	5
	Weight	12	12
	Contribution	72	60
Roadway Geometrics: This is a new facility with eight-foot shoulders that will better accommodate non-motorized travel. Design speed will be increased to 50 mph.	Measure	Degree	Degree
	Rating	7	9
	Weight	9	9
	Contribution	63	81
Constructibility: Delays only for joining bypass to the current alignment.	Measure	Degree	Degrees
	Rating	2	10
	Weight	9	9
	Contribution	18	90
Total Performance:		**464**	**609**
Net Change in Performance:			**+31%**

Define "catastrophic failure" to mean that both lanes are closed or lost, and that re-opening the road to one-way traffic will take more than two weeks; or that any failure is wider than can be bridged by a Bailey bridge or other temporary bridge that can be hauled in. We are assuming a single catastrophic failure rather than an initial failure followed by a series of additional failures so that re-opening the road would require considerable time.

Minimum right-of-way needed = 150 feet in width

Two lane facility, 8-foot shoulders, 50-mph design speed

Length of Simpson Bypass = 4 miles (southerly terminus PM 12.5, northerly PM 16.3). The bypass without tunnel assumes that a structure is needed at the north end to minimize tree take. Both Simpson Bypass alternatives assume a bridge at Wilson Creek at the south end.

(4 miles x 5,280 ft/mi x 150 ft)/43,560 ft/ac = approximately 72 acres total right-of-way required, including 3 acres of old growth redwoods.

Redwood National Park right-of-way at the Wilson Creek terminus does not include old growth redwood forest, but it was not included in right-of-way estimate. Park right-of-way is not equivalent to old growth tree impacts. Del Norte Redwoods State Park is assumed to have more old growth trees than National Park lands along the highway alignment, although the eastern part of the State Park does include some previously harvested lands.

The Simpson Bypass with tunnel (Idea AR-15) includes a half-mile tunnel under parkland at the northerly terminus, but it would still require park right-of-way (largely subterranean easement) and impacts to old growth forest for the north tunnel portal.

Will need design exceptions in order to construct a 50-mph road that does not meet current design standards for design speed.

Assumes balanced cut and fill to avoid disposal costs.

Any of the proposed bypass alternatives would have improved geometrics, including shoulders wider than on the existing alignment.

Wider shoulders could accommodate bicyclists.

Existing alignment would be relinquished to parks for park use.

Cost figures are based on the 1987 Wilson Creek Bluffs PSR alternative "E" using an escalation factor of 2.09 to account for a six percent increase over 15 years.

INITIAL COSTS
SR 101 Roadway Stabilization

Caltrans

TITLE
Simpson Land Bypass without Tunnel

NUMBER B(1)

PAGE NO. 8 of 8

CONSTRUCTION ELEMENT	ORIGINAL CONCEPT				ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Roadway Excavation	M^3	36,000	$15	$540,000			$0
Traffic Control System	LS	1	$2,000,000	$2,000,000			$0
Class 1 Aggregate Subbase	M^3	4,600	$25	$115,000			$0
Class 2 Aggregate Base	M^3	1,900	$35	$66,500			$0
Asphalt Concrete	tonne	3,900	$60	$234,000			$0
Other roadway items (drainage, clear/grub, etc.)	LS	1	$95,000	$95,000			$0
10% Mobilization	ea	1	$0	$0			$0
ROADWAY SUBTOTAL				*$3,050,500*			*$0*
ROADWAY MARK-UP	*35%*			*$1,067,675*			*$0*
VA ADDED MARK-UP				*$10,000*			*$0*
ROADWAY TOTAL				*$4,128,175*			*$72,000,000*
STRUCTURE ITEMS							
Tieback Walls	LS	1	$26,400,000	$26,400,000			$0
10% Mobilization	ea	1	$2,640,000	$2,640,000			$0
STRUCTURE SUBTOTAL				*$29,040,000*			*$0*
STRUCTURE MARK-UP	*25%*			*$7,260,000*			*$0*
VA ADDED MARK-UP				*$0*			*$0*
STRUCTURE TOTAL				*$36,300,000*			*$17,000,000*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition		1	$370,000	$370,000	1	$1,000,000	$1,000,000
Utility Relocation							
Relocation Assistance							
Demolition							
Title and Escrow Fees							
RIGHT-OF-WAY TOTAL				*$370,000*			*$1,000,000*
ENVIRONMENTAL MITIGATION ITEMS							
		1	$80,000	$80,000			$0
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign	0.1			$4,087,818			$0
Project Engineering							
TOTAL				$44,965,993			$90,000,000
TOTAL (Rounded)				$44,966,000			$90,000,000
						SAVINGS	($45,034,000)

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Simpson Land Bypass without Tunnel	**NUMBER** B.1

Team Member: Dan Adams

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Mike Eagan

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Gary Garofalo

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Deborah Harmon

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Jackson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Simpson Land Bypass without Tunnel	**NUMBER** B.1

Team Member: Jon Kaneshiro

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Susan Morrison

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Aida Parkinson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Stapleton

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ANALYSIS ALTERNATIVE *SR 101 Roadway Stabilization*		Caltrans	
FUNCTION: Align Roadway		**IDEA NO.** AR-3, 15, 23	**ALTERNATIVE NO.** B.2
TITLE: Simpson Bypass with Tunnel			**PAGE NO.** 1 of 7

ORIGINAL CONCEPT:

Minor roadway realignment and stabilization with soldier pile tieback walls above and below the road. This is alternative 2B in the February 1995 PSR.

ALTERNATIVE CONCEPT:

This alternative does not meet the project's original constraint to stay within the Caltrans alignment and right-of-way. However, this alternative is considered because it is a long-term solution to the slope instability that would have fewer impacts to park resources than a realignment within or close to the existing right-of-way.

Under this alternative and variations, a new two-lane alignment would be constructed to the east with the intent of avoiding or minimizing impacts to parklands, especially old growth forest. This alternative would allow the highway to be constructed on more stable ground, which would reduce traffic interruptions and delays from road failure and subsequent repairs. This would reduce long-term recurring maintenance costs.

This alternative would allow the new highway to be constructed to a 50-mph design speed. The existing alignment would be relinquished to the parks for park uses. Bypass alternatives require right-of-way from private landowners and parks.

The bypass variations have a southerly terminus at the mouth of Wilson Creek (post mile 12.5). One variation, which we have identified as the Simpson Bypass, would be similar to the Alternative R alignment as depicted on the Wilson Creeks Bluff Bypass in the 1994 Corridor Study (Alternative E in the 1987 PSR). This alignment has a northerly terminus at post mile 16.3; this is one of the shortest feasible bypass alignments, but it still requires right-of-way through old growth forest in Del Norte Coast Redwoods State Park. A variation of this alternative includes a tunnel at the northern terminus as a way of minimizing the take of old growth trees. This alternative includes a half-mile long tunnel that would require the take of approximately six old growth trees within the Caltrans right-of-way for the construction of its northern portal.

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 44,966,000	$ 0	$ 0	$ 44,966,000
Alternative Concept	$ 137,000,000	$ 0	$ 0	$ 137,000,000
Savings	$ (92,034,000)	$ 0	$ 0	$ (92,034,000)

Team Member:	Aida Parkinson Doug Jackson	**Discipline:**	Environmental Structures Construction	**PERFORMANCE:**	**+19%**

ADVANTAGES:

- Long-term solution to stability problem
- Tunnel is outside all known slide planes
- Reduces long-term recurring maintenance costs
- Reduces traffic delays and interruptions
- Building on stable grounds avoids potential for catastrophic failure that would result in long-term traffic delays and interruptions
- Road would have favorable geometrics
- Constructed with conventional methods, with potential for balanced cut and fill
- Road would presumably have improved maintainability if constructed on stable ground
- Existing alignment would allow traffic flow without major construction delays during project construction
- Possible reuse of existing alignment for park purposes
- Maintains historic elements of existing highway that make it eligible for listing on the National Register

DISADVANTAGES:

- Does not meet purpose and need of SHOPP project
- Requires substantial project funding
- Requires right-of-way from private landowners and/or parks
- Might require legislation to establish a demonstration project, like the Prairie Creek Bypass, in order to obtain necessary funding
- Stormwater management measures likely to be expensive due to amount of new ground disturbance
- Curve radius is less than standard at approximately 80 kph
- SSD with 2.4-m shoulder is ~95 m and less than 130 standard

DISCUSSION / JUSTIFICATION:

Bypass alternatives may be one of the few technically feasible long-term engineering solutions to the stability problem posed by the current alignment. A bypass could be constructed with conventional techniques and would allow traffic flow on the existing alignment during bypass construction. Recurring maintenance and repair costs for the existing alignment would be reduced, but substantial project funding would be required. Funding for the Prairie Creek Bypass was obtained through legislation for a demonstration project.

It is not possible to determine the timing or extent of a catastrophic road failure. In the event of a widespread catastrophic failure as might occur in a large subduction earthquake or major winter storm that produces widespread flooding and road failures, emergency funding might be available, but this cannot be factored into project planning. Re-opening a route following catastrophic road failure might require weeks, which would create significant problems for Del Norte County and travelers and businesses in southwestern Oregon and northwestern California.

Environmental groups and park agencies have consistently requested that Caltrans study bypass options as a long-term solution to avoid impacts to parklands from repairs required by slope failures on the existing alignment, and from highway improvements needed to accommodate modern transportation. Bypass alternatives all require some park right-of-way, because parklands extend in a strip along the coast between Klamath and Crescent City. However, some parklands, mostly in the National Park, have been previously harvested, so that an alignment might be planned that avoids or minimizes impacts to old growth trees.

DISCUSSION / JUSTIFICATION (Continued):

Impacts to old growth trees would be difficult to mitigate through purchase of private tracts of old growth, because there is very little old growth redwood forest remaining in private ownership.

The existing highway alignment is eligible for listing on the National Register of Historic Places. Bypassing the current alignment would retain the historic character of the existing highway. Continual repairs to the existing highway over the long term might adversely affect the historic character.

A bypass would not feature the ocean views available on the current alignment. A bypass would be designed with wider shoulders than the current alignment. Wider shoulders would accommodate bicyclists and would substantially improve bicyclist safety.

The shorter (Simpson) bypass would improve the experience of hikers on the California Coastal Trail, because these hikers would not have to cross the primary highway around post mile 15.7.

TECHNICAL REVIEWER COMMENTS:

Right-of-Way – Some right-of-way will be required, and it would be very difficult to acquire.

Friends of Del Norte County – How long will it take to be built? Reply: The key is money for building the road, which is uncertain; it could be SHOPP or it could be STIP.

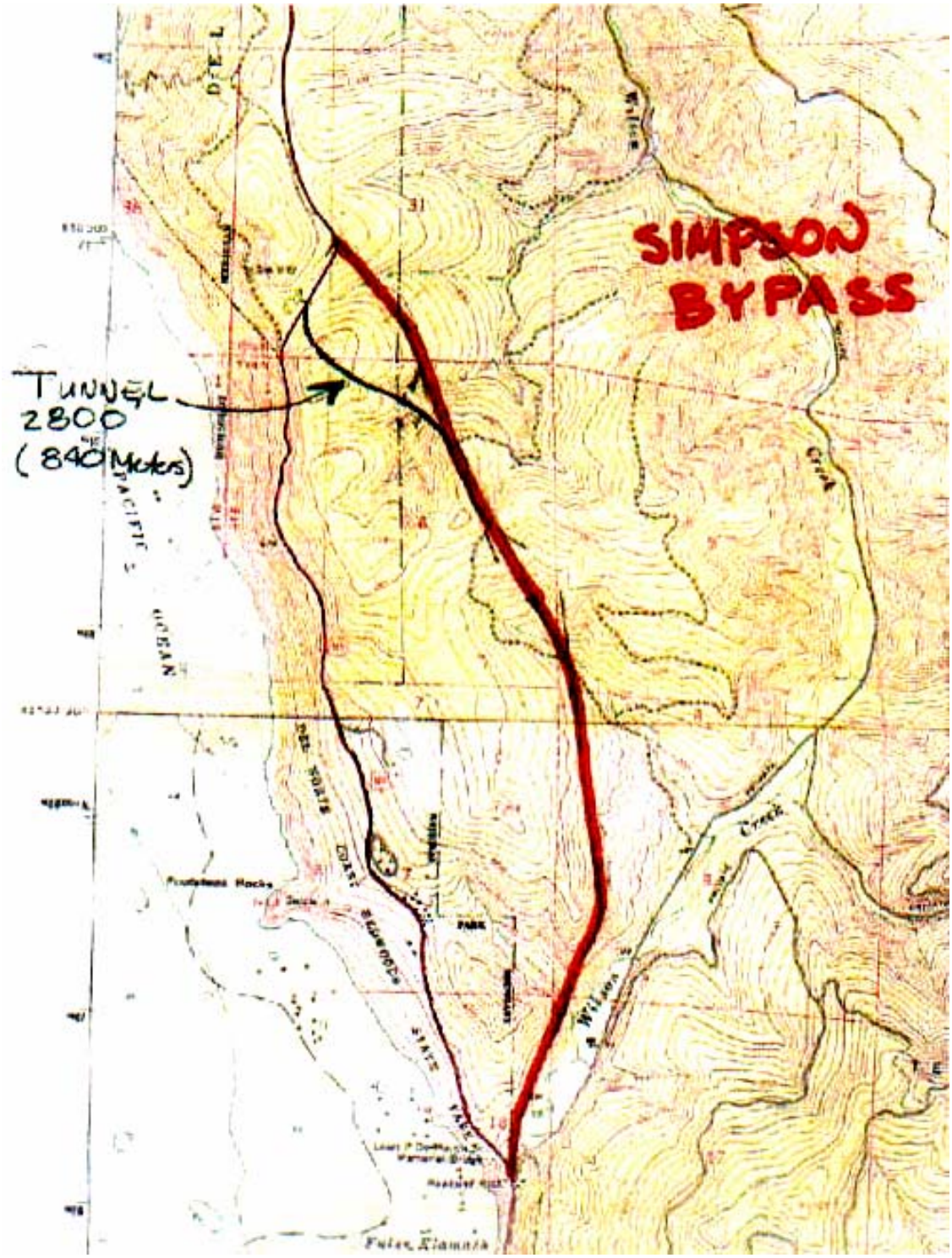
Friends of Del Norte County – Were the significant impacts to Wilson Creek considered? Reply, yes. Items such as avoiding the slide plane and park impacts were considered.

IMPLEMENTATION CONSIDERATIONS:

Right-of-way take from Simpson would be politically difficult. Prairie Creek Bypass required condemnation to obtain right-of-way.

Any impacts to old growth trees are viewed unfavorably by environmental groups and park agencies.

SKETCHES *SR 101 Roadway Stabilization*	Caltrans	
TITLE: Simpson Bypass with Tunnel	**NUMBER** B.2	**PAGE NO.** 4 of 7



Copied from 1994 SR 101 Corridor Study (based on 1987 Wilson Creek bypass proposals) showing bypass

PERFORMANCE MEASURES *SR 101 Roadway Stabilization*		Caltrans	
TITLE: Simpson Bypass with Tunnel		**NUMBER** B.2	**PAGE NO.** 5 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
Right of Way:	Measure	Degree	Degree
	Rating	10	8
	Weight	29	29
	Contribution	290	232
Maintainability: This is a new facility that avoids unstable areas altogether.	Measure	Degree	Degree
	Rating	1	10
	Weight	24	24
	Contribution	24	240
Environmental Impact: This alternative takes trees but substantially fewer old growth than the non-tunnel Simpson alternative. Impacts to parklands are lessened because it requires a subterranean easement over most of its length.	Measure	Degree	Degree
	Rating	8	6
	Weight	17	17
	Contribution	136	102
Aesthetics:	Measure	Degree	Degree
	Rating	5	6
	Weight	12	12
	Contribution	60	72
Roadway Geometrics: This is a new facility with eight-foot shoulders that will better accommodate non-motorized travel. Design speed will be increased to 50 mph.	Measure	Degree	Degree
	Rating	3	9
	Weight	9	9
	Contribution	27	81
Constructibility: Construction of a tunnel will be slightly more difficult than the non-tunnel Simpson alternative.	Measure	Degree	Degrees
	Rating	10	8
	Weight	9	9
	Contribution	90	72
Total Performance:		**627**	**746**
Net Change in Performance:			**+19%**

Cost factors for this analysis are based on a straight alignment and do not include costs for a tunnel at the northern terminus.

Minimum right-of-way needed = 150 feet in width

Two lane facility, 8-foot shoulders, 50-mph design speed

Length of (Simpson) Bypass = 4 miles (southerly terminus pm 12.5, northerly pm 16.3). Assumes that a structure is needed at north end to minimize tree take.

(4 miles x 5,280 ft/mi x 150 ft)/43,560 ft/ac = approximately 72 acres total right-of-way, including 3 acres of old growth redwoods.

RNP right-of-way at Wilson Creek terminus does not include old growth forest but was not included in right-of-way estimate. Park right-of-way is not equivalent to old growth tree impacts. Del Norte Redwoods State Park is assumed to have more old growth trees than National Park lands in this area.

The Simpson Bypass with tunnel discussed (AR 15) includes a half-mile tunnel under parkland at the northerly terminus, but it would still require park right-of-way (largely subterranean easement) and impacts to old growth forest for the north tunnel portal.

Will need design exceptions in order to construct a 50-mph road that does not meet current design standards.

Assumes balanced cut and fill to avoid disposal costs.

Any of the proposed bypass alternatives would have improved geometrics, including shoulders wider than on the existing alignment. Wider shoulders could accommodate bicyclists.

The existing alignment would be relinquished to parks for park use.

INITIAL COSTS
SR 101 Roadway Stabilization

Caltrans

TITLE
Simpson Bypass with Tunnel

NUMBER B(2)

PAGE NO. 7 of 7

CONSTRUCTION ELEMENT	ORIGINAL CONCEPT				ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Roadway Excavation	M^3	36,000	$15	$540,000			$0
Traffic Control System	LS	1	$2,000,000	$2,000,000			$0
Class 1 Aggregate Sub base	M^3	4,600	$25	$115,000			$0
Class 2 Aggregate Base	M^3	1,900	$35	$66,500			$0
Asphalt Concrete	tonne	3,900	$60	$234,000			$0
Other roadway items(drainage, clear/grub, etc)	LS	1	$95,000	$95,000			$0
10% Mobilization	ea	1	$0	$0			$0
ROADWAY SUBTOTAL				*$3,050,500*			*$0*
ROADWAY MARK-UP	*35%*			*$1,067,675*			*$0*
VA ADDED MARK-UP				*$10,000*			*$0*
ROADWAY TOTAL				*$4,128,175*			*$72,000,000*
STRUCTURE ITEMS							
Tieback Walls	LS	1	$26,400,000	$26,400,000			$0
10% Mobilization	ea	1	$2,640,000	$2,640,000			$0
Tunnel							$50,000
STRUCTURE SUBTOTAL				*$29,040,000*			*$64,000,000*
STRUCTURE MARK-UP	*25%*			*$7,260,000*			
VA ADDED MARK-UP							
STRUCTURE TOTAL				*$36,300,000*			*$64,000,000*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition		1	$370,000	$370,000	1	$1,000,000	$1,000,000
Utility Relocation							
Relocation Assistance							
Demolition							
Title and Escrow Fees							
RIGHT-OF-WAY TOTAL				*$370,000*			*$1,000,000*
ENVIRONMENTAL MITIGATION ITEMS							
		1	$80,000	$80,000			$0
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign	0.1			$4,087,818			$0
Project Engineering							
TOTAL				$44,965,993			$137,000,000
TOTAL (Rounded)				$44,966,000			$137,000,000
						SAVINGS	($92,034,000)

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Simpson Bypass with Tunnel	**NUMBER** B.2

Team Member: Dan Adams

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Mike Eagan

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Gary Garofalo

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Deborah Harmon

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Jackson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Simpson Bypass with Tunnel	**NUMBER** B.2

Team Member: Jon Kaneshiro

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Susan Morrison

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Aida Parkinson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Stapleton

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ANALYSIS ALTERNATIVE *SR 101 Roadway Stabilization*		Caltrans
FUNCTION: Realign Roadway	**IDEA NO.** AR-2	**ALTERNATIVE NO.** C.1
TITLE: One Large Diameter Bored Two-Lane Tunnel		**PAGE NO.** 1 of 8

ORIGINAL CONCEPT:

Use soldier pile tieback walls above and below the roadway. (Alternative "2B" of 1995 PSR)

ALTERNATIVE CONCEPT:

Background: The PSR (1995) Alternative 1 provides for a relatively short 375-meter long large diameter (12 meters wide by 11 meters high ID) two-lane tunnel with a total realignment length, including approaches of 644 meters. The Preliminary Geotechnical Report (PGR) (2001) evaluated Alternative 1 and determined that the proposed alignment went through an active landslide.

The PGR proposed a longer tunnel (p. 22 and Figure 25) (and approach) alignment, which would be about 1,585 meters (5,200 feet) long that would for the most part bypass the active landslide. However, at the VA meeting (August 20-23, 2001), the investigators (Gary Garofalo and Chris Willis) indicated the tunnel alignment still passed through part of the old landslide mass. This older landslide mass, which was once thought to be dormant, now appears to be *potentially active* to *active.* The proposed longer tunnel, "Alternative 1A", therefore, presents risks, albeit less than Alternative 1, which does not meet the requirements/goals/objectives of the project in terms of security/risks.

It should be noted that all tunnel concepts, including the original alternative, do not meet the project's original constraint to stay within the Caltrans alignment and right-of-way. All of the alternatives would at least require subsurface easements outside the right-of-way, if not more at the approaches to the tunnel portals.

Alternative: In Alternative 1A from the PGR, a large diameter single-bore tunnel is considered. The alignment would still pass, however, through the old landslide mass, which appears to be *potentially active* to *active.*

ADVANTAGES:

- Tunnels, although expensive, are environmentally friendly, as they provide little disruption to the surface environment, which is a specific advantage for this alignment
- Constructibility concerns with respect to standup time and the ability to span the excavation are better in better ground
- Limited tree and environmental impacts compared to some other alternatives
- Aesthetic advantage comes from relinquishing the existing alignment to parks for park purposes (recreation)
- Limited closure of roads during construction
- Reduces environmental impacts compared to other alternatives
- Out of right-of-way in terms of subsurface easements

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 45,419,000	$ 0	$ 0	$ 45,419,000
Alternative Concept	$ 177,931,000	$ 0	$ 0	$ 177,931,000
Savings	$ (132,512,000)	$ 0	$ 0	$ (132,512,000)

Team Member: Jon Kaneshiro	**Discipline:** Tunneling	**PERFORMANCE:** -14%

DISADVANTAGES:

- This alternative assumes poor ground conditions; one large diameter bore will be more expensive than a double-bore tunnel.
- Security and risk of catastrophic failure is not eliminated, since the tunnels would still pass through a *potentially active* to *active* landslide (at least two and possibly four landslide slip planes).
- Deep slide slope stabilization measures, such as slope stressing, would still be required, especially at the southernmost landslide
- Approaches would be out of the right-of-way, and trees would still be impacted at portals and at slope stressing areas
- Reduces aesthetics (no view)
- Maintenance (ventilation, drainage, lighting and signaling costs)
- Fire and safety concerns
- Tunnel failure would result in a much longer closure
- Significant maintenance costs
- Expensive capital costs
- Fatal flaw would be no remediation of landslide plane

DISCUSSION / JUSTIFICATION:

Special measures may be taken to limit damage to the tunnel due to potential movement along the landslide shear plane. These include the following:

- Articulation of the liner by providing flexible construction joints
- Contingency plan for catastrophic event
- Deep slope stressing
- Portal stabilization

Construction in very poor and difficult ground:

- Several excavation scenarios are possible
- Sequential Excavation Method (SEM) or the New Austrian Tunneling Method (NATM), which are small incremental excavation units of the poor rock mass with flexible and easy to install initial support including rock bolts, wire mesh, lightweight steel girder, or H-beam or I-beam sets and shotcrete.
- Stacked Drift – Small incremental excavations by SEM or NATM, as above, where the initial liner is formed around the perimeter of the larger excavation and eventually facilitates the initial support of the larger excavation.

This alternative assumes that the slide can be mitigated with slope stressing, which can be quite expensive. Since this has to be implemented anyway, consideration of a shorter tunnel with slope stressing may also be considered in the future.

TECHNICAL REVIEWER COMMENTS:

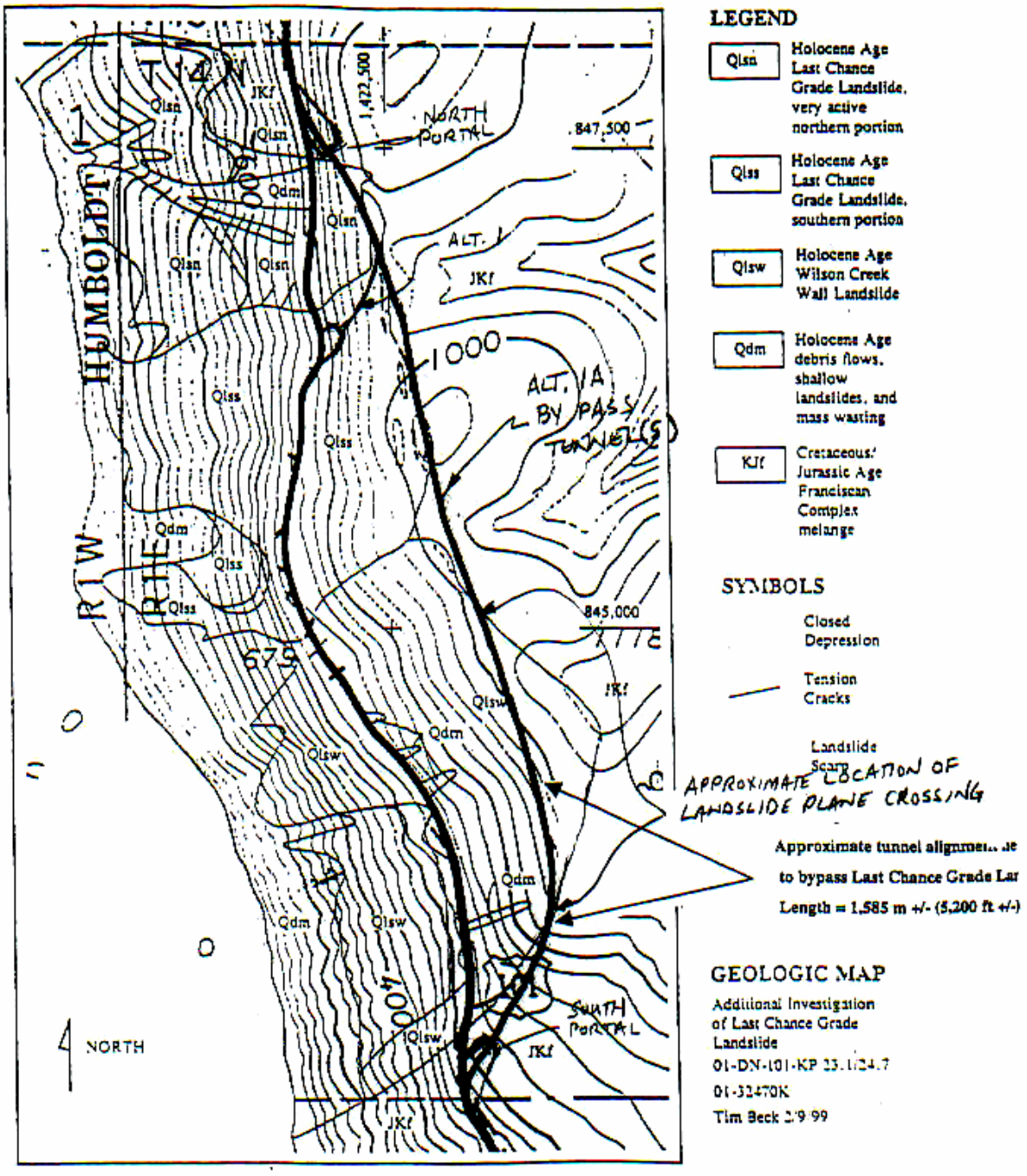
Design – A deep concern is that in the southern end of the project there are two slip planes that are potentially active. Problems with interfacing the tunnel with existing slides are anticipated.

Friends of Del Norte County – Environmental impacts at the portals are a concern. Construction may be hazardous e.g. underground work, gas, confined spaces. During the construction of the Collier Tunnel, lives were lost. There is considerable water and rain in this project area.

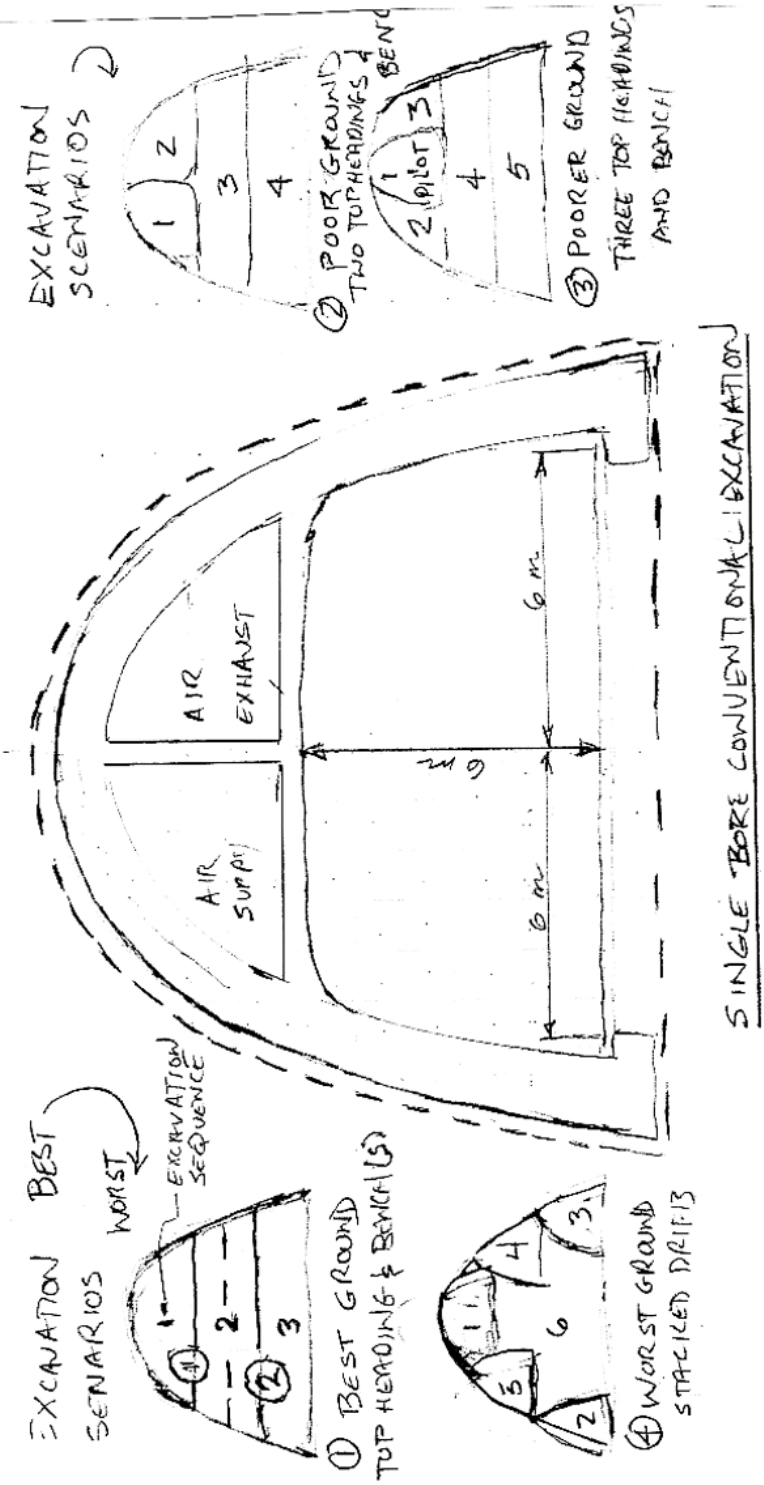
IMPLEMENTATION CONSIDERATIONS:

- Perform detailed engineering and geotechnical investigations, including implementation of the "observational method", to monitor landslide movements.
- Landslide stabilization at portals and deep slope stressing would also be recommended. Environmental disruption would be similar to Alternative D, Idea No. IS-11-15, etc., as would additional costs, but perhaps for a smaller or more limited area.
- Ventilation and fire safety are critical for long highway tunnels.
- An additional geotechnical contingency on costs is recommended because of the nature of subsurface construction. An additional 15%, as recommended by Sperry *Costing Contingencies* (Civil Engineering Magazine, April 1988) should be used during planning studies.

Scale: 1 inch = 800 ft +/-



SKETCHES *SR 101 Roadway Stabilization*	Caltrans	
TITLE: One Large Diameter Bored Two-Lane Tunnel	**NUMBER** C.1	**PAGE NO.** 5 of 8



PERFORMANCE MEASURES *SR 101 Roadway Stabilization*		Caltrans	
TITLE: One Large Diameter Bored Two-Lane Tunnel		**NUMBER** C.1	**PAGE NO.** 6 of 8
CRITERIA	**Performance**	**Original**	**Alternative**
Right of Way: Same rating as twin-bore tunnels. Right-of-way impact is limited to portal approaches and stabilization measures near portals. Subsurface easement requirements are easy to obtain and do not truly impact adjacent properties.	Measure	Degree	Degree
	Rating	4	5
	Weight	29	29
	Contribution	290	145
Maintainability: Slightly worse rating than twin-bore tunnels. Concern of through failure planes damaging tunnel liner, hence repairs and possible shutdowns. Also, there are significant ventilation, drainage, lighting, and signage costs.	Measure	Degree	Degree
	Rating	6	3
	Weight	24	24
	Contribution	144	72
Environmental Impact: Same rating as twin-bore tunnels. Only impacts approaches to portals and portal stabilization areas. Slope stressing to stabilize landslide would also have temporary environmental impact.	Measure	Degree	Degree
	Rating	3	5
	Weight	17	17
	Contribution	51	85
Aesthetics: Same rating as twin-bore tunnels. No view, like twin bore, although there are benefits of gaining old alignment for parks and recreation.	Measure	Degree	Degree
	Rating	6	3
	Weight	12	12
	Contribution	72	36
Roadway Geometrics: Same rating as twin-bore tunnels. Essentially the same roadway geometrics. With a tunnel, obstacles will be difficult geology. We can align the tunnel for preferred roadway geometry.	Measure	Degree	Degree
	Rating	7	5
	Weight	9	9
	Contribution	63	45
Constructibility: Slightly worse rating than twin-bore tunnels. A larger span is more difficult to build than smaller spans. Disposal issues and construction period over 4 years.	Measure	Degree	Days
	Rating	2	2
	Weight	9	9
	Contribution	180	18
Total Performance:		**464**	**401**
Net Change in Performance:			**-14%**

PSR 1995 Alt. 1 Structures (including 25% contingency and mobilization)

$\frac{\$28,351,000}{1,230 \text{ ft.}} = \$23,050/\text{ft.}$

$\frac{\$23,050}{1.25} = \$18,440/\text{ft.}$ without 25% Seems reasonable even for 2001 (judgment)

Add 5%

$19,362/ft. = $63,500/m (Seems reasonable, check below)

Quantity Single Bore Conventional Excavation

Excavation (counting squares from invert)

Level	1	2	3	4	5	6	7	8	9	10	11	12	13
Qty (m^2)	16	16	15.5	15	14.5	14	13.5	13	12	11	9	7	2

Total ≅ 158.5 m^3/m

Concrete Liner

Footing	2 x 2 m =	4 m^3/m
Arch	2 x 1.2 x 14 =	33.6 m^3/m
Soffit/Vent	2(.3 m x 6 m) + .3 m x 3.5 m =	4.65 m^3/m
	Σ	42.25 m^3/m

Check:

Bare Excavation $100/cy = $131/$m^3$ % Arango et. al. (1992) ≅ 35%

158.5 m^3/m x $131/$m^3$ = $20,763/m (33.2%)

Tunnel Liner $400/cy = $524/$m^3$

42.25 m^3/m x $524/$m^3$ = $22,139/m (35.4%) ≠ 20%

Initial Support (*Abramson's Slakey, 1990)

*Cumberland Gap Tunnel very poor ground 47% Initial Liner

53% Final Liner

0.47/0.53 x $22,139 = $19,632/m (31.4%) ≠ 45%

Total Tunnel $62,535/m (100%)

INITIAL COSTS
SR 101 Pavement Stabilization

Caltrans

TITLE
One Large Diameter Bored Two-Lane Tunnel

NUMBER	PAGE NO.
C-1	8 of 8

CONSTRUCTION ELEMENT		ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Roadway Excavation	M^3	36,000	$15	$540,000	107,044	$15	$1,605,660
Class 1 AS	M^3	4,600	$25	$115,000	5,199	$25	$129,975
Class 2 AB	M^3	1,900	$35	$66,500	2,217	$35	$77,595
AC	tonne	3,900	$60	$234,000	4,445	$60	$266,700
Miscellaneous Items*	ls	1	$95,000	$95,000	1	$123,000	$123,000
Traffic Control Systems	ls	1	$2,000,000	$2,000,000			$2,202,930
Subtotal				*$3,050,500*			
Roadway Mobilization	%	0	$3,050,500	$305,050	2,202,930	$0.10	$220,293
ROADWAY SUBTOTAL				*$3,355,550*			*$2,423,223*
ROADWAY MARK-UP	*35%*			*$1,174,443*			*$848,128*
VA ADDED MARK-UP	*ls*	1	$10,000	*$10,000*	*1*	*$10,000*	*$10,000*
ROADWAY TOTAL				*$4,539,993*			*$3,281,351*
STRUCTURE ITEMS							
Tunnel	m			$0	1,585	$63,500	$100,647,500
Disputes Review Board	ls			$0	1	$50,000	$50,000
Partnering	ls			$0	1	$100,000	$100,000
Maintain Traffic (4 years)	day			$0	1,460	$500	$730,000
Traffic Control	ls			$0	1	$2,100,000	$2,100,000
Slope Stressing	ls			$0	1	$13,000,000	$13,000,000
Tieback Walls	ls	1	$26,400,000	$26,400,000			$0
STRUCTURE SUBTOTAL				*$26,400,000*			*$116,627,500*
STRUCTURE MARK-UP							
Mobilization	*10%*	0.10	$26,400,000	*$2,640,000*			*$11,662,750*
Subtotal				*$29,040,000*			
Contingency	25%	0.25	$29,040,000	*$7,260,000*			*$29,156,875*
Subtotal				*$36,300,000*			*$157,447,125*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition (1.34x$528,000)*	ls	1	$370,000	$370,000	1	$707,000	$707,000
Subsurface Easement (14 acresx$5,000)	ls			$0	1	$70,000	$70,000
Relocation Assistance							
Demolition							
Title and Escrow Fees							
RIGHT-OF-WAY TOTAL				*$370,000*			*$777,000*
ENVIRONMENTAL MITIGATION ITEMS							
1.34 x $188,000 *	ls	1	$80,000	$80,000	1	$250,000	$250,000
Subtotal R/W, STRUCT, R/W, Envr.				*$41,289,993*			*$161,755,476*
CAPITAL OUTLAY SUPPORT ITEMS	10%			$4,128,999			$16,175,548
Reengineering and Redesign							
Project Engineering							
TOTAL				$45,418,992			$177,931,024
TOTAL (Rounded)				$45,419,000			$177,931,000
						SAVINGS	($132,512,000)

*** = PSR, 1995, Alt 1**

VA TEAM ALTERNATIVE REVIEW *SR101 Roadway Stabilization*	**Caltrans**
TITLE: One Large Diameter Bored Two-Lane Tunnel	**NUMBER** C.1

Team Member: Dan Adams

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Mike Eagan

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Gary Garofalo

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☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Deborah Harmon

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Jackson

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VA TEAM ALTERNATIVE REVIEW *SR101 Roadway Stabilization*	**Caltrans**
TITLE: One Large Diameter Bored Two-Lane Tunnel	**NUMBER** C.1

Team Member: Jon Kaneshiro

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Susan Morrison

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Aida Parkinson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Stapleton

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ANALYSIS ALTERNATIVE *SR 101 Pavement Stabilization*		Caltrans	
FUNCTION:	Realign Roadway (Bypass Traffic Tunnel Around Landslide)	**IDEA NO.** AR-11	**ALTERNATIVE NO.** C.2
TITLE:	Two Smaller Diameter Bored One-Way Tunnels		**PAGE NO.** 1 of 8

ORIGINAL CONCEPT:

Use soldier pile tieback walls above and below the roadway (Alternative "2B" of 1995 PSR)

ALTERNATIVE CONCEPT:

Background: The PSR (1995) Alternative 1 provides for a relatively short 375-meter long large diameter (12 meters wide by 11 meters high ID) two-lane tunnel with a total realignment length, including approaches of 644 meters. The Preliminary Geotechnical Report (PGR) (2001) evaluated Alternative 1 and determined that the proposed alignment went through an active landslide. The PGR proposed a longer tunnel (p. 22 and Figure 25) (and approach) alignment, which would be about 1,585 meters (5,200 feet) long that would, for the most part, bypass the active landslide. However, at the VA meeting (August 20-23, 2001), the investigators (Gary Garofalo and Chris Willis) indicated the tunnel alignment still passed through part of the old landslide mass. This older landslide mass, which was once thought to be dormant, now appears to be *potentially active* to *active*. The proposed longer tunnel, "Alternative 1A", therefore presents risks, albeit less than Alternative 1, which does not meet the requirements/goals/objectives of the project in terms of security/risks.

It should be noted that all tunnel concepts, including the original alternative, do not meet the project's original constraint to stay within the Caltrans alignment and right-of-way. All of the alternatives would at least require subsurface easements outside the right-of-way, if not more at the approaches, to the tunnel portals.

Alternative: Instead of a single highway tunnel, two smaller (6- to 7-meter ID) (7- to 8-m OD) diameter bores are proposed, on a similar alignment to the proposed Alternative 1A (see Idea No. AR-2, Alternative C-1). The alignment would still pass, however, through the old landslide mass, which appears to be *potentially active* to a*ctive.*

ADVANTAGES:

- Although the proposed alternative still passes through the old landslide, the ability to repair a damaged portion of the tunnel is easier, which is a specific advantage of this alignment
- There may be less possible damage and risk to the individual bores in the event of a catastrophic event
- Tunnels, although expensive, are environmentally friendly, as they provide little disruption to surface environment
- This alternative offers all of the advantages of Alternative 1A, at a lower cost
- Constructibility concerns with respect to standup time (the ability to span the excavation) are better in better ground
- Limited tree and environmental impacts compared to many other alternatives
- Aesthetic advantage comes from relinquishing the existing alignment to parks for park purposes (recreation)
- Limited closure of roads during construction
- Saves environment compared to other alternatives
- Out of right-of-way in terms of subsurface easements

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 45,419,000	$ 0	$ 0	$ 45,419,000
Alternative Concept	$ 169,533,000	$ 0	$ 0	$ 169,533,000
Savings	$ (124,114,000)	$ 0	$ 0	$ (124,114,000)

Team Member: Jon Kaneshiro	**Discipline:** Tunneling	**PERFORMANCE:** +2%

DISADVANTAGES:

- Security and risk of catastrophic failure is not eliminated, since the tunnels would still pass through a *potentially active"* to "*active* landslide (at least two and possibly four landslide slip planes)
- Deep slide slope stabilization measures, such as slope stressing, would still be required, especially at the southernmost landslide
- Approaches would be out of ROW and trees would still be impacted at portals and at slope stressing areas
- Reduces aesthetics (no view)
- Maintenance (ventilation, drainage, lighting and signaling costs)
- Fire and safety concerns
- Tunnel failure results in a much longer closure
- Significant maintenance costs
- Expensive capital costs
- Fatal flaw would be no remediation of landslide plane

DISCUSSION / JUSTIFICATION:

Special measures may be taken to limit damage to the tunnel due to potential movement along the landslide shear plane. This includes the following:

- Articulation of the liner by providing flexible construction joints
- Contingency plan for catastrophic event
- Deep slope stressing and portal stabilization

Savings of quantities compared to a single-bore tunnel are:

- About 13.5 cubic meters/meter of tunnel for excavation
- About 3.6 cubic meters/meter of tunnel for concrete liner

Construction in very poor and difficult ground:

- Easier to do in smaller spans compared to single bore
- A horseshoe-shaped shield may be used. Conceivably, a mechanized circular excavation may be used

This alternative assumes that the slide can be mitigated with slope stressing, which can be quite expensive. Since this has to be implemented anyway, consideration for a shorter tunnel with slope stressing may also be considered in the future.

TECHNICAL REVIEWER COMMENTS:

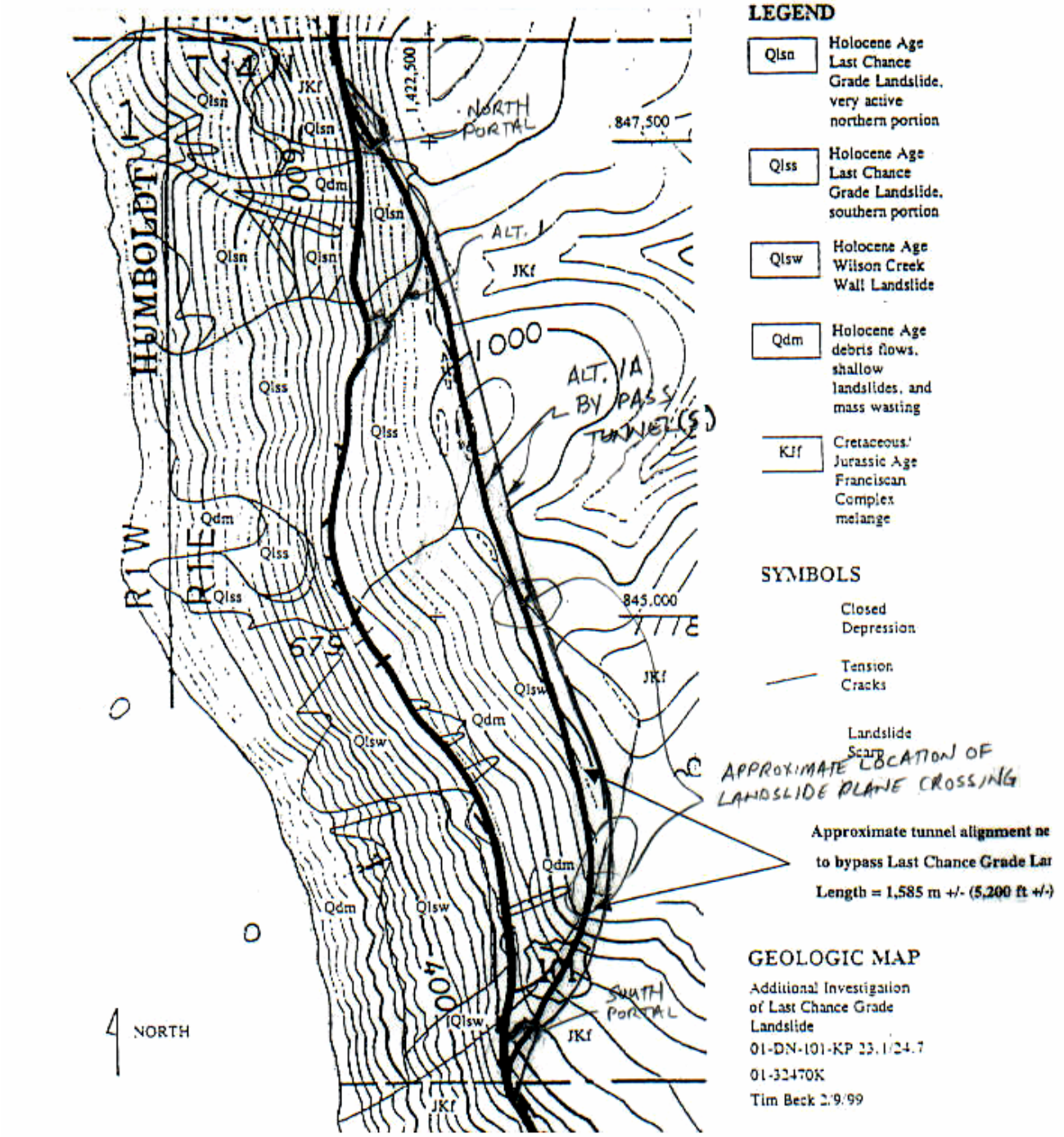
Design – A deep concern is that in the southern end of the project there are two slip planes that are potentially active. Problems with interfacing the tunnel with existing slides are anticipated.

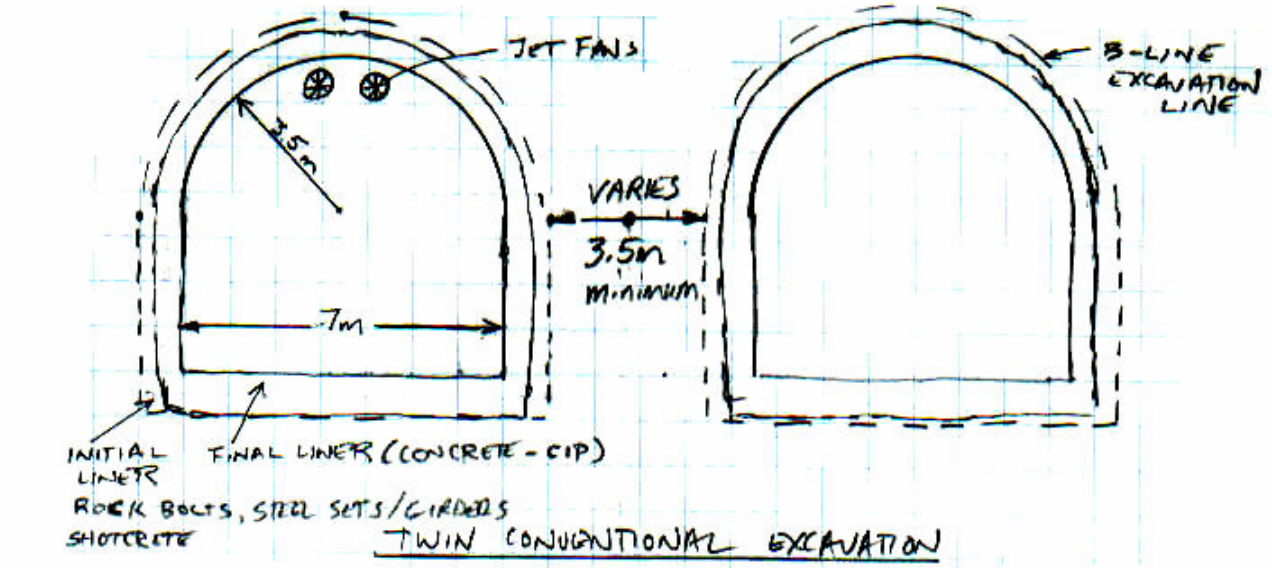
Friends of Del Norte County – Environmental impacts at the portals are a concern. Construction may be hazardous; e.g., underground work, gas, confined spaces. During the construction of the Collier Tunnel, lives were lost. Considerable water and rain in this project area.

IMPLEMENTATION CONSIDERATIONS:

- Perform detailed engineering and geotechnical investigations, including implementation of the "observational method" to monitor landslide movements.
- Landslide stabilization at portals and deep slope stressing would also be recommended. Environmental disruption would be similar to Alternative D, Idea No. IS-11-15, etc., as would additional costs, but perhaps for a smaller or more limited area.
- Ventilation and fire safety are critical for long highway tunnels
- An additional geotechnical contingency on costs is recommended because of the nature of subsurface construction. An additional 15%, as recommended by Sperry *Costing Contingencies* (Civil Engineering Magazine, April 1988) should be used during planning studies.

Scale: 1 inch = 800 ft +/-





TWIN CONVENTIONAL EXCAVATION

LIKELY EXCAVATION SCENARIOS

① FULL SHIELD ∩ - HORSESHOE SHAPED

② TOP HEADING & BENCH (3)

③ TWO TOP HEADINGS BENCH (6)

ASSUMED MINIMUM HEIGHT = 6.m FOR VEHICLE CLEARANCE

PERFORMANCE MEASURES *SR 101 Pavement Stabilization*	Caltrans		
TITLE: Two Smaller Diameter Bored One-Way Tunnels	**NUMBER** C.2		**PAGE NO.** 6 of 8
CRITERIA	**Performance**	**Original**	**Alternative**
Right of Way: Same rating as single-bore tunnel. Essentially, no change in right-of-way.	Measure	Degree	Degree
	Rating	4	5
	Weight	29	29
	Contribution	116	145
Maintainability: Slightly better rating than single-bore tunnel. Two tunnels allow traffic flow in another tunnel if severe distress should occur in one.	Measure	Degree	Degree
	Rating	6	4
	Weight	24	24
	Contribution	144	96
Environmental Impact: Same rating as single-bore tunnel. Essentially, same approaches as a single-bore tunnel.	Measure	Degree	Degree
	Rating	3	5
	Weight	17	17
	Contribution	51	85
Aesthetics: Same rating as single-bore tunnel. No view, like a single bore, although there are benefits of gaining old alignment for parks and recreation.	Measure	Degree	Degree
	Rating	6	3
	Weight	12	12
	Contribution	72	36
Roadway Geometrics: Same rating as single-bore tunnel. Essentially the same roadway geometrics.	Measure	Degree	Degree
	Rating	7	7
	Weight	9	10
	Contribution	63	70
Constructibility: Slightly better rating than single-bore tunnel. A smaller span, when standup time is poor, is easier to construct. Disposal issues and construction period over 4 years. Slight savings in material excavation and supply. A moderate amount of disposal of material compared to the through cut alternative at the top of the ridge.	Measure	Degree	Days
	Rating	2	4
	Weight	9	10
	Contribution	18	40
Total Performance:		**464**	**472**
Net Change in Performance:			**+2%**

Quantity Twin Conventional Excavation

Excavation

$\frac{\Pi}{2}$ $(4.5\ m)^2 + 9 \times 4.5 = 72.3\ m^3/m \times 2 = 145\ \frac{m^3}{m}$

Concrete Liner (0.6 m thick)

ARCH	Π (3.8 m x 0.6 m) = 7.2 m^3/m x 2 =	14.3
Walls	2(3.8 m x 0.6) = 4.6 m^3/m x 2 =	9.1
Invert	.1 m x 7.6 = 7.6 m^3/m x 2 =	15.2
		38.6 m^3/m

Excavation difference from single bore, see C-1*

$\Delta = 13.5\ m^3/m$

Liner:

$\Delta = 3.6\ m^3/m$

*Compared to single bore

Excavation = 158.5 m^3/m

Liner = 42.25 m^3/m

Δ Exc. = $\frac{13.5}{158.5} = 8.52\%$ Use 8.5% savings

Δ Liner = $\frac{3.6}{42.25} = 8.52\%$

\$63,500 x (~91.5%) = \$58,100 Use \$58,500/m

INITIAL COSTS

REALIGN ROADWAY: (Bypass Traffic Tunnel Around Landslide)

Caltrans

TITLE
Two Smaller Diameter Bored One-Way Tunnels

NUMBER	**PAGE NO.**
C-2	8 of 8

CONSTRUCTION ELEMENT	**ORIGINAL CONCEPT**				**ALTERNATIVE CONCEPT**		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Roadway Excavation	M^3	36,000	$15	$540,000	107,044	$15	$1,605,660
Class 1 AS	M^3	4,600	$25	$115,000	5,199	$25	$129,975
Class 2 AB	M^3	1,900	$35	$66,500	2,217	$35	$77,595
AC	tonne	3,900	$60	$234,000	4,445	$60	$266,700
Miscellaneous Items (see next page)*	ls	1	$95,000	$95,000	1	$123,000	$123,000
Traffic Control Systems	ls	1	$2,000,000	$2,000,000			$0
Subtotal				*$3,050,500*			*$2,202,930*
Roadway Mobilization	%	0	$3,050,500	$305,050			$220,293
ROADWAY SUBTOTAL				*$3,355,550*			*$4,626,153*
ROADWAY MARK-UP	*35%*			*$1,174,443*			*$1,619,154*
VA ADDED MARK-UP	*ls*	1	$10,000	*$10,000*	*1*	*$10,000*	*$100,000*
ROADWAY TOTAL				*$4,539,993*			*$6,345,307*
STRUCTURE ITEMS	m			$0	1,585	$58,500	$92,722,500
Disputes Review Board	ls			$0	1	$50,000	$50,000
Partnering	ls			$0	1	$100,000	$100,000
Maintain Traffic (4 years)	day			$0	1,460	$500	$730,000
Traffic Control	ls			$0	1	$2,100,000	$2,100,000
Slope Stressing	ls			$0	1	$13,000,000	$13,000,000
Tieback Walls	ls	1	$26,400,000	$26,400,000			$0
STRUCTURE SUBTOTAL				*$26,400,000*			*$108,702,500*
STRUCTURE MARK-UP							
Mobilization	*10%*			*$2,640,000*			*$10,870,250*
Subtotal				*$29,040,000*			
Contingency	25%	0.25	$29,040,000	*$7,260,000*			*$27,175,625*
Subtotal				*$36,300,000*			*$146,748,375*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition (1.34x$528,000)*	ls	1	$370,000	$370,000	1	$707,000	$707,000
Subsurface Easements (14 ac x $5,000)	ls			$0	1	$70,000	$70,000
Relocation Assistance							
Demolition							
Title and Escrow Fees							
RIGHT-OF-WAY TOTAL				*$370,000*			*$777,000*
ENVIRONMENTAL MITIGATION ITEMS							
1.34x$188,000 *	ls	1	$80,000	$80,000	1	$250,000	$250,000
Subtotal				*$41,289,993*			*$154,120,682*
CAPITAL OUTLAY SUPPORT ITEMS	10%			$4,128,999			$15,412,068
Reengineering and Redesign							
Project Engineering							
TOTAL				$45,418,992			$169,532,750
TOTAL (Rounded)				$45,419,000			$169,533,000
						SAVINGS	($124,114,000)

*** = PSR, 1995, Alt 1**

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Two Smaller Diameter Bored One-Way Tunnels	**NUMBER** C.2

Team Member: Dan Adams

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Mike Eagan

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Gary Garofalo

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Deborah Harmon

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Jackson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: One Large Diameter Bored Two-Lane Tunnel	**NUMBER** C.2

Team Member: Jon Kaneshiro

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Susan Morrison

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Aida Parkinson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Stapleton

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ANALYSIS ALTERNATIVE *SR 101 Roadway Stabilization*		Caltrans	
FUNCTION:	Stabilize Slope	**IDEA NO.** AR-12	**ALTERNATIVE NO.** D
TITLE:	Retaining Wall with Localized Limited Slope Stressing (Alternative 2A of PSR)		**PAGE NO.** 1 of 6

ORIGINAL CONCEPT:

Use soldier pile tieback walls above and below the roadway. (Alternative 2B of 1995 PSR)

ALTERNATIVE CONCEPT:

On a slight realignment (i.e., fewer turns and longer tangent sections), construct a new roadway between post mile 15.0 and 15.6 using two means to stabilize the deep slide plane (but with minimal effect), and at the same time stabilize the shallow debris flows. A soldier pile wall and slope stressing, both having anchor tendons below the deep slide plane, would be employed. This alternative does not stabilize the deep slide plane to the south. This alternative is not recommended because it goes outside the Caltrans right-of-way and results in an unacceptable impact to old growth trees.

ADVANTAGES:

- Achieves some stability on deep slide plane (but very little)
- Achieves much stability against shallow slide planes
- Good roadway geometrics
- Reduces maintenance costs from existing
- Upslope aesthetics suffer for up to 20 years (until some regrowth occurs) but some restrictions on type of vegetation
- Provides uniform shoulder widths

DISADVANTAGES:

- Might fail in a design seismic event
- Some movement in severe rainfall events possible
- Major right-of-way take up slope from roadway (which could be planted)
- Construction over several seasons
- Very long piles, above-average difficulty to construct
- Same as above for tendons
- Clear cut above roadway
- Significant stormwater pollution prevention (SWPP) issues
- Some restrictions on revegetation potential of the area, likely not redwoods in some areas

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 44,966,000	$ 0	$ 0	$ 44,966,000
Alternative Concept	$ 39,871,000	$ 0	$ 0	$ 39,871,000
Savings	$ 5,095,000	$ 0	$ 0	$ 5,095,000

Team Member: Gary Garofalo	**Discipline:** Geotechnical	**PERFORMANCE:** -19%

DISCUSSION / JUSTIFICATION:

Allows a more stable roadway with less maintenance and traffic slowdowns. Stabilizes upslope (shallow) slide. Extremely deep slide plane presents major technical and cost challenges for this alternative. Possible major damage in a design earthquake is possible.

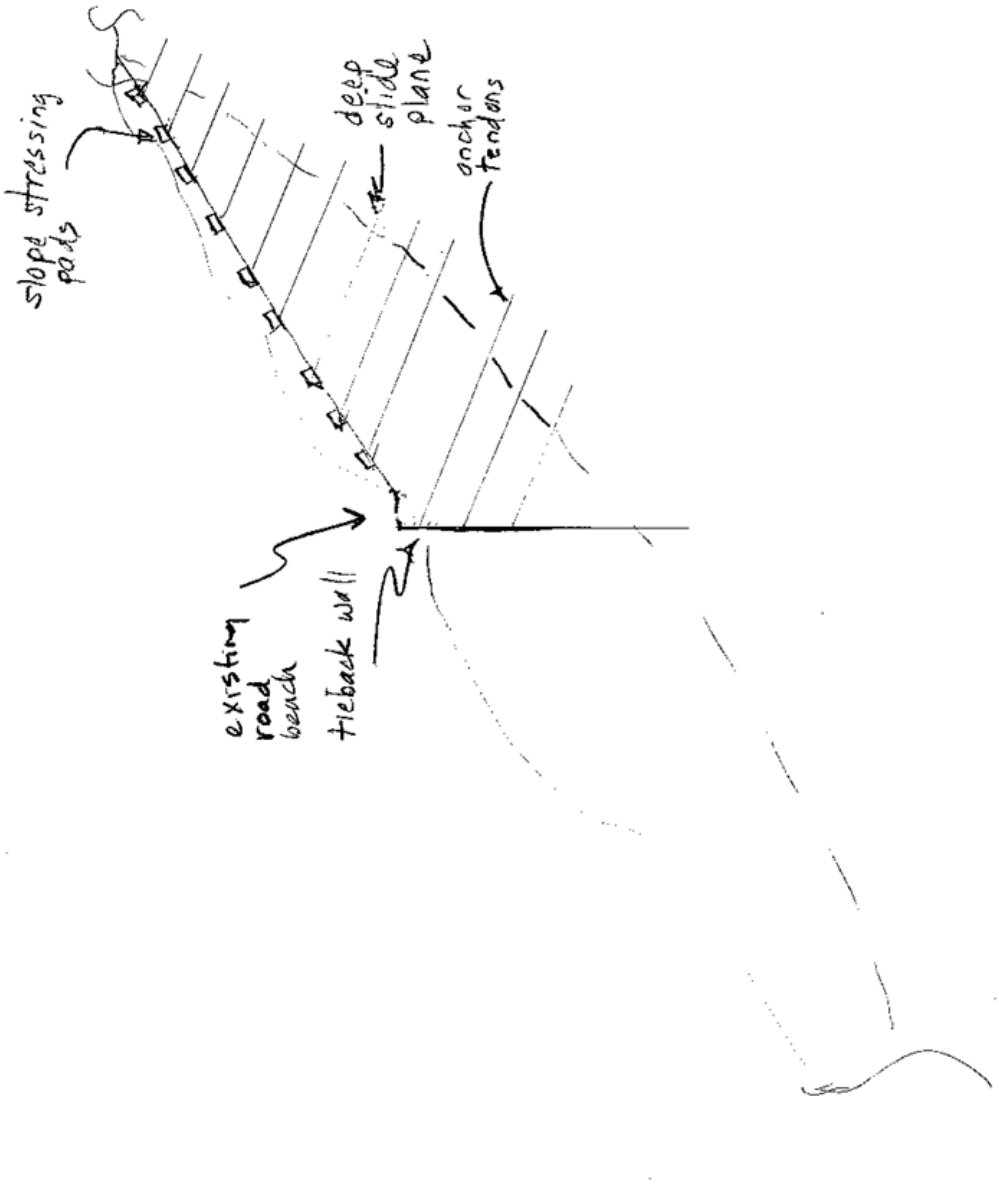
There is precedence, however, for using high-capacity anchors to stabilize a deep-seated landslide. Examples include PG&E's Belden Siphon, Manoa Slide (HI).

High capacity tendons are used in civil works to stabilize spillways.

TECHNICAL REVIEWER COMMENTS:

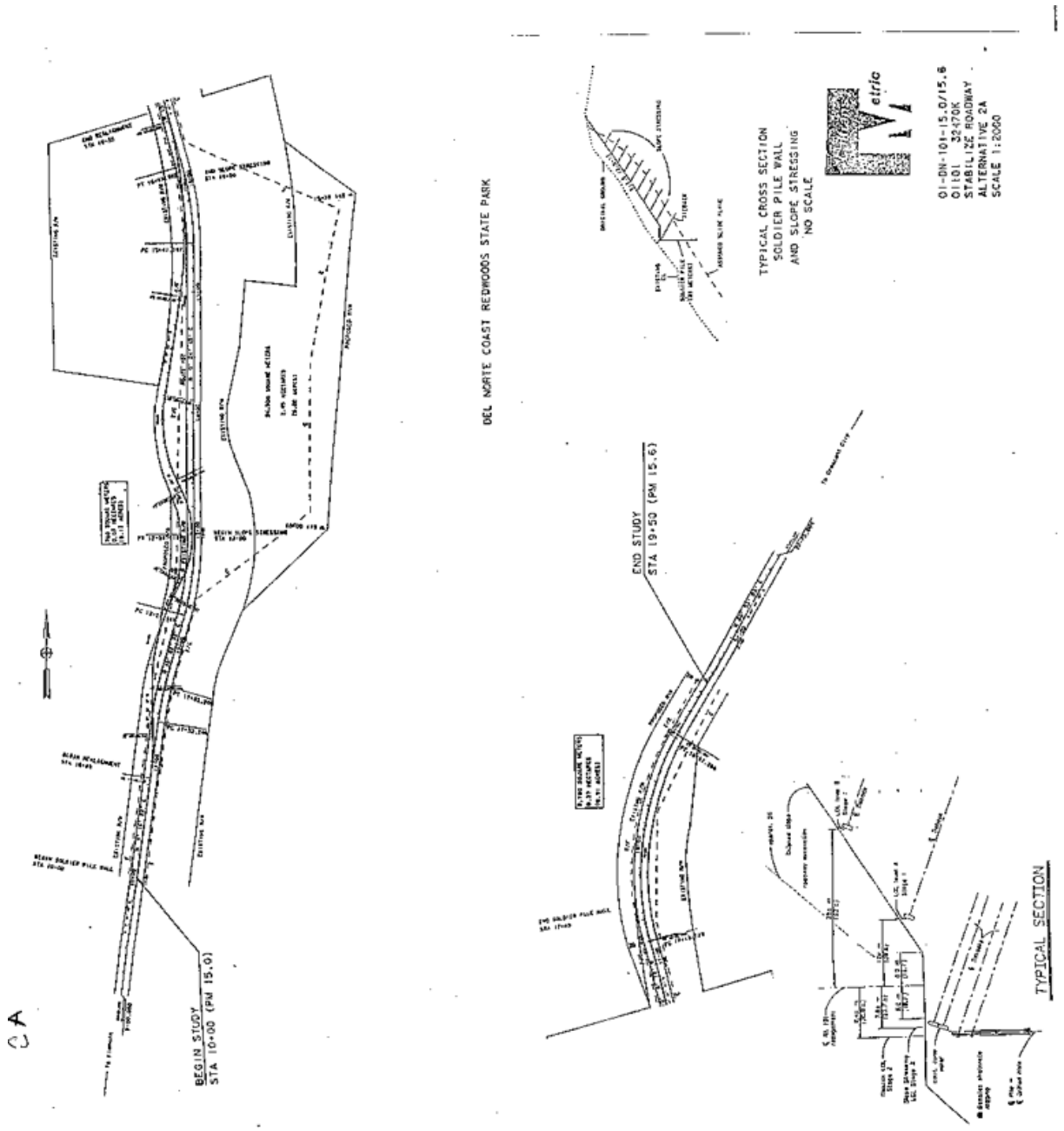
Design – This is point slope stabilization. Could possibly revegetate with a step approach.

IMPLEMENTATION CONSIDERATIONS:


slope stressing pads
deep slide plane
anchor tendons
existing road bench
tieback wall

PERFORMANCE MEASURES ***SR 101 Roadway Stabilization***	**Caltrans**		
TITLE: Retaining Wall with Localized Limited Slope Stressing	**NUMBER** D		**PAGE NO.** 4 of 6
CRITERIA	**Performance**	**Original**	**Alternative**
Right-of-Way: Significant take upslope from the existing roadway, denuding the hillside for slope stressing.	Measure	Degree	Degree
	Rating	4	2
	Weight	29	29
	Contribution	116	58
Maintainability: Would reduce seasonal maintenance due to shallow sliding (from PM 15.13 to 15.17 and 15.20 to 15.37).	Measure	Degree	Degree
	Rating	6	6
	Weight	24	24
	Contribution	144	144
Environmental Impact: Significant park and old growth take.	Measure	Degree	Degree
	Rating	3	2
	Weight	17	17
	Contribution	51	34
Aesthetics: Walls and slope stressing are unappealing.	Measure	Degree	Degree
	Rating	6	3
	Weight	12	12
	Contribution	72	36
Roadway Geometrics: Improves vertical and horizontal profiles.	Measure	Degree	Degree
	Rating	7	8
	Weight	9	9
	Contribution	63	72
Constructibility: Difficulty maintaining traffic during construction.	Measure	Days	Days
	Rating	2	4
	Weight	9	9
	Contribution	18	36
Total Performance:		**464**	**380**
Net Change in Performance:			**-19%**

ASSUMPTIONS & CALCULATIONS *SR 101 Roadway Stabilization*	Caltrans	
TITLE: Retaining Wall with Localized Limited Slope Stressing	**NUMBER** D	**PAGE NO.** 5 of 6



INITIAL COSTS
SR 101 Roadway Stabilization

Caltrans

TITLE
Retaining Wall with Localized Limited Slope Stressing

NUMBER D

PAGE NO. 6 of 6

CONSTRUCTION ELEMENT	ORIGINAL CONCEPT				ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Roadway Excavation	M^3	36,000	$15	$540,000	463,000	$15	$6,945,000
Traffic Control System	LS	1	$2,000,000	$2,000,000	1	$2,000,000	$2,000,000
Class 1 Aggregate Subbase	M^3	4,600	$25	$115,000	4,600	$25	$115,000
Class 2 Aggregate Base	M^3	1,900	$35	$66,500	1,900	$35	$66,500
Asphalt Concrete	tonne	3,900	$60	$234,000	3,900	$60	$234,000
Other roadway items (drainage, clear/grub, etc.)	LS	1	$95,000	$95,000	1	$388,000	$388,000
Maintain Traffic	LS				1	$250,000	$250,000
10% Mobilization	ea	1	$0	$0	1	$999,850	$999,850
ROADWAY SUBTOTAL				*$3,050,500*			*$10,998,350*
ROADWAY MARK-UP	*35%*			*$1,067,675*			*$3,849,423*
VA ADDED MARK-UP				*$10,000*			*$10,000*
ROADWAY TOTAL				*$4,128,175*			*$14,857,773*
STRUCTURE ITEMS							
Tieback Walls	LS	1	$26,400,000	$26,400,000			
10% Mobilization	ea	1	$2,640,000	$2,640,000			
Tieback Walls and Slope Stressing	LS				1	$14,233,000	$14,233,000
10% Mobilization	ea				1	$1,423,000	$1,423,000
STRUCTURE SUBTOTAL				*$29,040,000*			*$15,656,000*
STRUCTURE MARK-UP	*25%*			*$7,260,000*			*$3,914,000*
VA ADDED MARK-UP							
STRUCTURE TOTAL				*$36,300,000*			*$19,570,000*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition		1	$370,000	$370,000			
Right-of-Way					7	$180,000	$1,283,400
Relocation Assistance							
Demolition							
Title and Escrow Fees							
RIGHT-OF-WAY TOTAL				*$370,000*			*$1,283,400*
ENVIRONMENTAL MITIGATION ITEMS							
		1	$80,000	$80,000			
	acre				7	$75,000	$534,750
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign	0.1			$4,087,818			$3,624,590
Project Engineering							
TOTAL				$44,965,993			$39,870,513
TOTAL (Rounded)				$44,966,000			$39,871,000
						SAVINGS	$5,095,000

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Retaining Wall with Localized Limited Slope Stressing	**NUMBER** D

Team Member: Dan Adams

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Mike Eagan

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Gary Garofalo

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Deborah Harmon

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Jackson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Retaining Wall with Localized Limited Slope Stressing	**NUMBER** D

Team Member: Jon Kaneshiro

☐ I have reviewed this alternative and agree with it as it is written
☑ I have reviewed this alternative and suggest the following (or attached) changes

Disagree with the advantage that states, "Achieves stability on the deep slide plane (but very little)".

Team Member: Susan Morrison

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Aida Parkinson

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Stapleton

☑ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ANALYSIS ALTERNATIVE *SR 101 Roadway Stabilization*		Caltrans	
FUNCTION: Increase Stabilization		**IDEA NO.**	**ALTERNATIVE NO.** E
TITLE: Deep Slide Stabilization with Slope Stressing			**PAGE NO.** 1 of 7

ORIGINAL CONCEPT:

Minor roadway realignment and stabilize with a soldier pile tieback walls. (1995 PSR Alternative 2B)

ALTERNATIVE CONCEPT:

On the Last Chance Grade, north and south sides, attempt to stabilize the deep slide plane (and at the same time the shallower debris flows) using slope stressing. This alternative is similar to Project Study Report Option 2A, except that slope stressing would occur upslope and downslope of the roadway with the goal of stabilizing both the near surface debris flows, but more importantly, the deep-seated slide plane.

Slope stressing is a slope repair method whereby the frictional forces resisting the slide are increased by the imposition of forces using subsurface stressed tieback tendons and at ground level reinforced concrete pads (to distribute the forces). In plan view, the slope stressing appear as horizontal rows, perhaps 20-40 feet apart, with concrete pads on the ground surface placed continuously, and tieback tendons through the pads in drilled holes, stressed and locked off, with the anchorage location being below the deep failure plane.

This alternative is not recommended because it goes outside the Caltrans right-of-way and results in unacceptable and substantial impact to old growth trees.

ADVANTAGES:

- Might improve stability on the deep-seated slide plane (enough to merit consideration)
- Improves maintainability of realigned roadway
- Improves roadway geometrics within the project limits

DISADVANTAGES:

- Stability by this method is not fully assessed at this time
- Expensive construction
- Lengthy time to construct
- Large right-of-way take needed both upslope and downslope of the current roadway
- Issues regarding taking of trees downslope, where few redwoods are located, and upslope, where many redwoods are located

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	**$**	**$**	**$**	**$**
Alternative Concept	**$** 80,000,000 to 125,000,000	**$**	**$**	**$**
Savings	**$**	**$**	**$**	**$**

Team Member: Gary Garofalo & Jon Kaneshiro	**Discipline:** Geotechnical	**PERFORMANCE:** **-2.6**

VALUE ANALYSIS ALTERNATIVE *SR 101 Roadway Stabilization*	Caltrans	
TITLE: Deep Slide Stabilization with Slope Stressing	**ALTERNATIVE NO.** E	**PAGE NO.** 2 of 7

DISCUSSION / JUSTIFICATION:

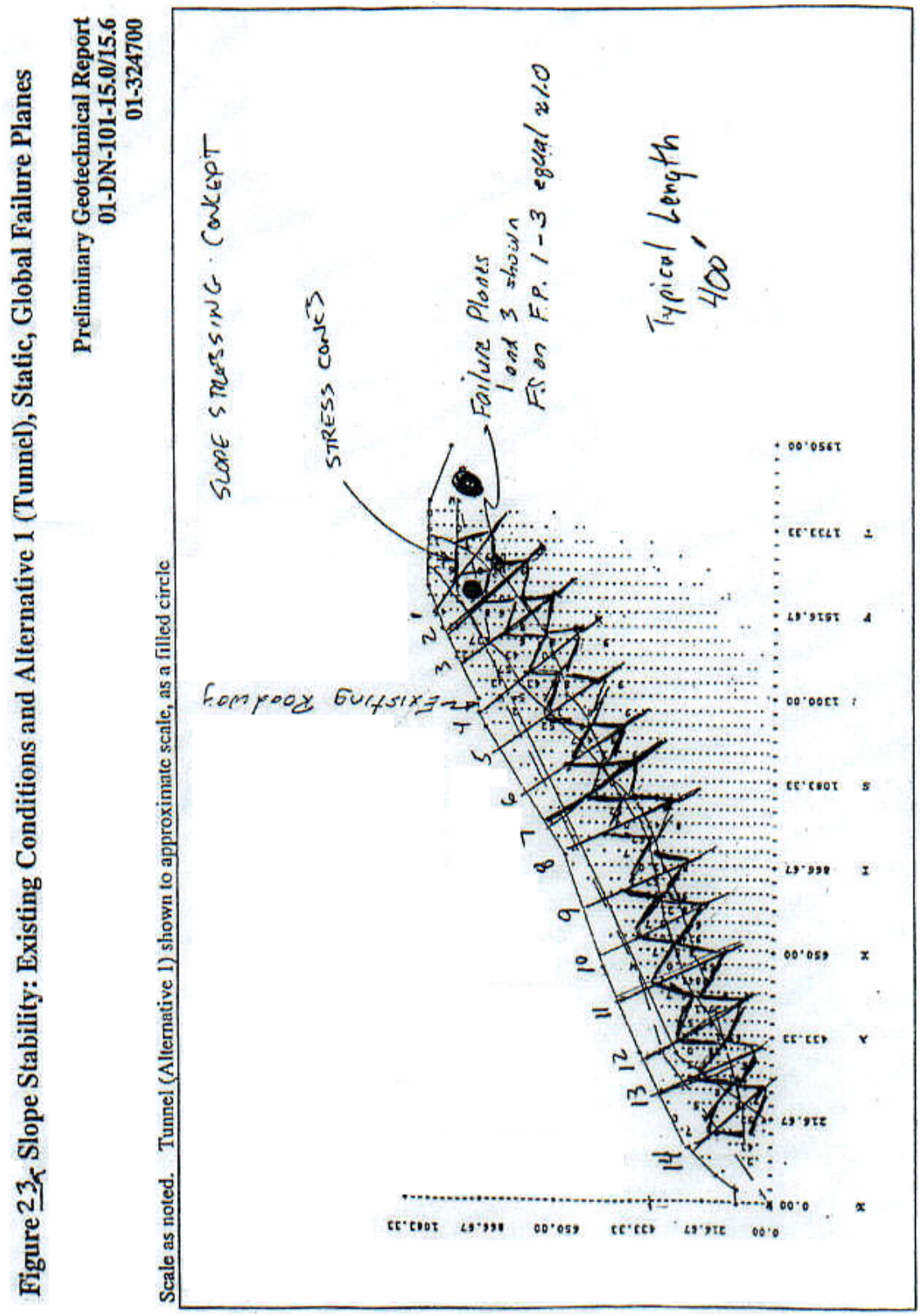
As most of the build options do not fully stabilize the slide (including under seismic events), an option that attempted to fully stabilize the slide was considered for comparison purposes. While not fully analyzed from the geotechnical viewpoint, this alternative was evaluated on the criteria established by the VA team.

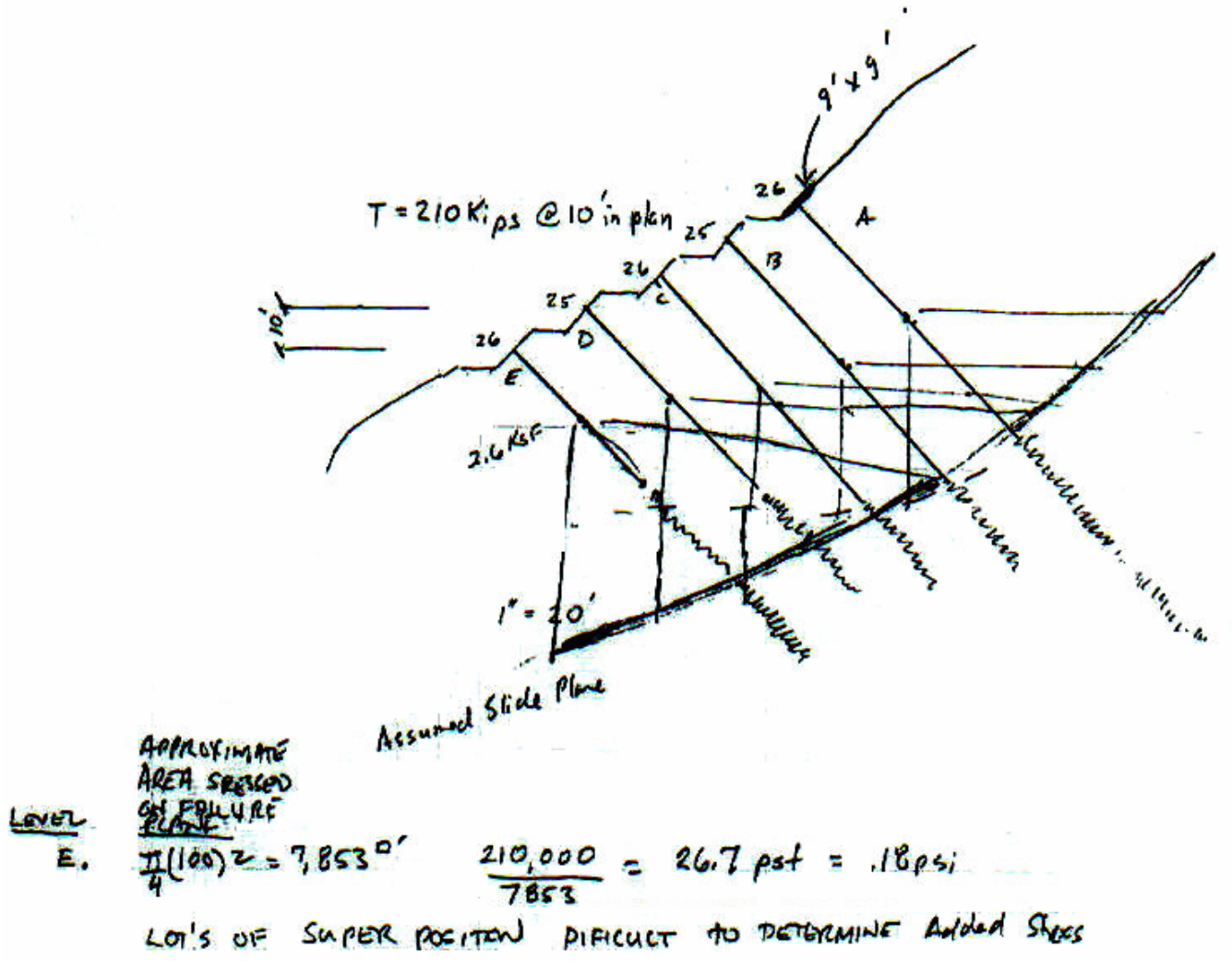
TECHNICAL REVIEWER COMMENTS:

While not fully analyzed from the geotechnical viewpoint, this alternative was evaluated on the criteria established by the VA team.

Cost estimates under some quick analysis could be as low as $80,000,000 to as high as $125,000,000.

IMPLEMENTATION CONSIDERATIONS:

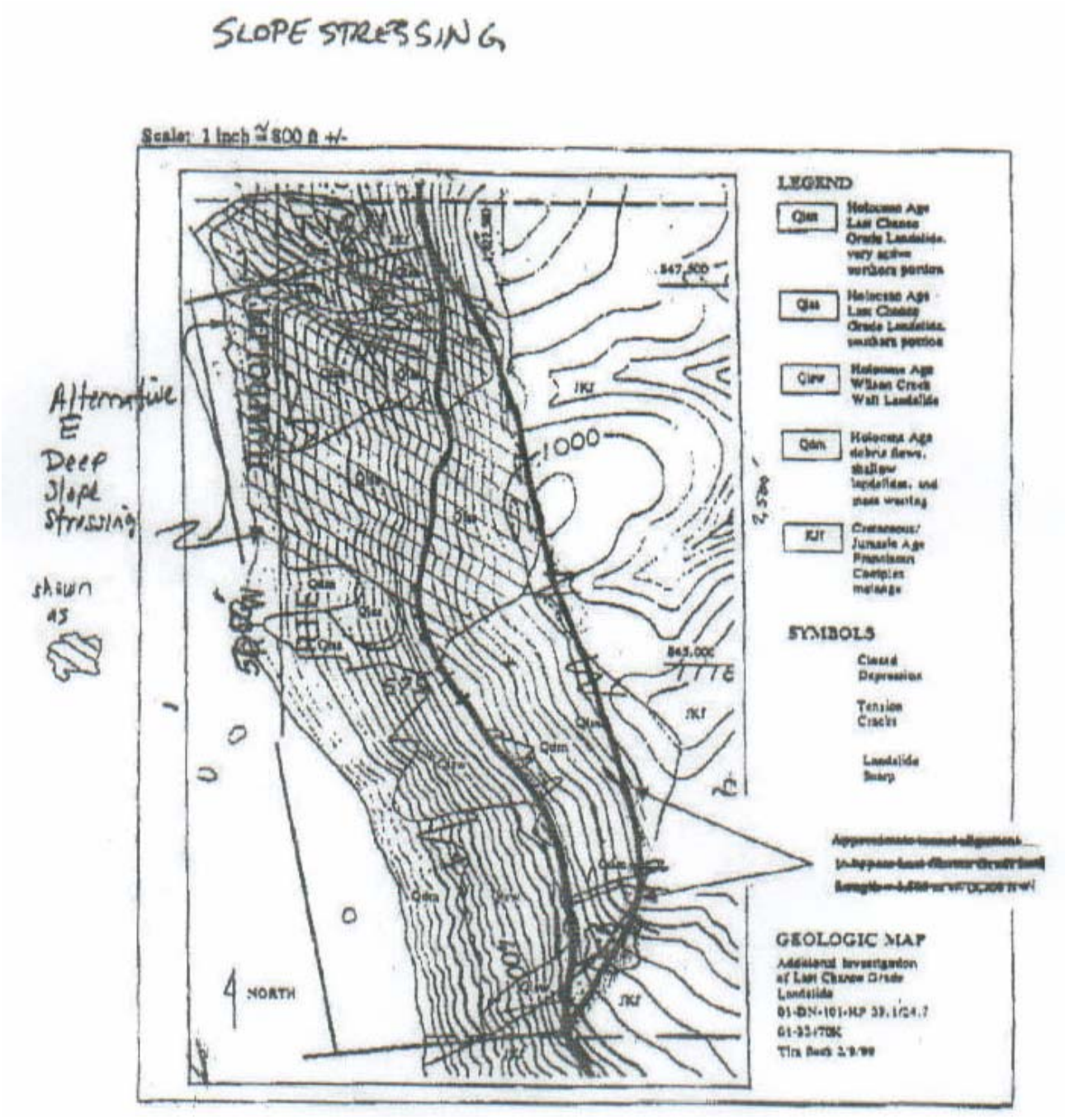

SLOPE STRESSING - CONCEPT
STRESS CONES
Failure Planes
1 and 3 shown
F.S on F.P. 1-3 equal 1.0
Typical Length
400'
Existing Roadway
Preliminary Geotechnical Report
01-DN-101-15.0/15.6
01-324700
Figure 23. Slope Stability: Existing Conditions and Alternative 1 (Tunnel), Static, Global Failure Planes
Scale as noted. Tunnel (Alternative 1) shown to approximate scale, as a filled circle



LEVEL — APPROXIMATE AREA STRESSED BY FAILURE PLANE

E. $\frac{\pi}{4}(100)^2 = 7,853^{\square'}$ $\quad \frac{210,000}{7853} = 26.7\ psf = .18\ psi$

LOT'S OF SUPER POSITION DIFICULT TO DETERMINE Added Stress


SLOPE STRESSING
Alternative E Deep Slope Stressing shown as
Scale: 1 inch = 800 ft +/-
LEGEND
Qls
Holocene Age Last Chance Creek Landslide, very active northern portion
Qlss
Holocene Age Last Chance Creek Landslide, southern portion
Qlcw
Holocene Age Wilson Creek Wall Landslide
Qdm
Holocene Age debris flows, shallow landsliding, and mass wasting
KJf
Cretaceous/ Jurassic Age Franciscan Complex melange
SYMBOLS
Closed Depression
Tension Cracks
Landslide Scarp
GEOLOGIC MAP
Additional Investigation of Last Chance Creek Landslide
NORTH
1000
847.500
843.000

PERFORMANCE MEASURES ***SR 101 Roadway Stabilization***	**Caltrans**		
TITLE: Deep Slide Stabilization with Slope Stressing	**NUMBER** E		**PAGE NO.** 6 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
Right-of-Way: It is estimated that at least 14 large swathes parallel to the shoreline would be required below and above the roadway for the slope stressing – much acreage, all in parkland (although fewer redwood trees exist downslope of roadway than upslope).	Measure	Degree	Degree
	Rating	4	2
	Weight	29	29
	Contribution	116	58
Maintainability: Improves on all counts (pending verification by further studies).	Measure	Degree	Degree
	Rating	6	9
	Weight	24	24
	Contribution	144	216
Environmental Impact: Poor – see discussion under right-of-way.	Measure	Degree	Degree
	Rating	3	2
	Weight	17	17
	Contribution	51	34
Aesthetics: Downslope there is a clear unobstructed view of the ocean, at a cost of removing trees. Upslope a large area of construction would exist. Some limitations on the type of trees that could be regrown in the immediate area of slope stressing would be present.	Measure	Degree	Degree
	Rating	6	3
	Weight	12	12
	Contribution	72	36
Roadway Geometrics: Reduces the number of short reverse curves.	Measure	Degree	Degree
	Rating	7	9
	Weight	9	9
	Contribution	63	81
Constructibility: Lengthy construction time, but could begin at several locations. Upslope there could be some excess material generated, but downslope would envision as conforming to the topography, and excess material would be disposed of onsite.	Measure	Degree	Degrees
	Rating	2	3
	Weight	9	9
	Contribution	18	27
Total Performance:		**464**	**452**
Net Change in Performance:			**-2.6%**

SLOPE STRESSING DATA

Caltrans 1.5 miles east of Mill Creek Bridge (Job 882; 1990, Mike Eagan Engineer of Record)
Bids: $1,181,000 to $1,830,000.
Engineer's Estimate: $1,040,000

Ditches, drains, debris, rocks, 5,450 feet of horizontal drains, benches, 128 tiebacks, 5 rows, 9-foot x 9-foot block footings, T = 210 kips, unbounded length 80', 80', 60', 45' = average of 68 lineal feet of slope horizontal, 50 foot vertical, 250 foot angled

$1.2 x 106 / 128 tiebacks = $9.375/tieback

(1.03)" = 1.38 (inflection)

SLOPE STRESSING DATA (INDEPENDENT CHECK)

PG&E's Belden Siphon

Telephone memo – Rob White of PG&E = 310 kips
9 strands: maximum 125 feet, minimum 90 feet; cased entire length unbounded
DBM estimate $2,200,000 (1993)
10 + 13 +12 +11 +13 +9 = 68, therefore $2,200,000/68 = $32,353
Slope area: 200 feet high x 200 feet wide x 2,000 feet long; therefore 280 feet x 2000 feet = 560,000 ft^2
Length is twice for Caltrans project and the cost is $64,594 per tieback
Inflation = 1.4775 (1.05 at 8 years)
Cost = $ 95,594/tieback
Tieback spacing is 90 feet

SLOPE STRESSING ONLY

14 tiebacks per ±90 feet of slope per row
Assume 5,000 lf of slope
5,000/90 = 56 tiebacks per row
Total number of tiebacks = 784
$95,600/tieback x 784 tiebacks = $74, 950,000
Structures on without engineering, contingencies, roadway improvements, etc.

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Deep Slide Stabilization with Slope Stressing *(NOTE: This alternative was written after the VA Session; therefore, it has not been reviewed by the VA Team.)*	**NUMBER** E

Team Member: Dan Adams

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Mike Eagan

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Gary Garofalo

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Deborah Harmon

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Jackson

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VA TEAM ALTERNATIVE REVIEW *SR 101 Roadway Stabilization*	**Caltrans**
TITLE: Deep Slide Stabilization with Slope Stressing	**NUMBER** E

Team Member: Jon Kaneshiro

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Susan Morrison

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Aida Parkinson

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Stapleton

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Project Analysis

PROJECT ANALYSIS

SUMMARY OF ANALYSIS

The following analysis tools were used to study the project:

- Project Issues and Constraints
- Lessons Learned on Site Visit
- Cost Model
- Function Analysis / FAST Diagram
- Performance Criteria Matrix
- Performance Rating Matrix

PROJECT ISSUES AND CONSTRAINTS

The following items were identified and addressed by the VA team:

- The project is in a seismically active location; large earthquakes could be experienced
- There are numerous slip planes in the project area; some are shallow and others are deep seated
- Redwood takes are to be kept to an absolute minimum, if any
- The Save the Redwoods League is concerned about impacts to memorial groves in the vicinity of the project
- The VA Study is constrained to the current Caltrans right-of-way; only minor takes would be considered
- The Fish and Wildlife Service would have concerns about threatened and endangered species
- Del Norte County would have concerns about the road being closed and access to southern destinations
- The need for a Coastal Development Zone Permit is a concern
- Short- and long-term roadway stabilization

LESSONS LEARNED ON SITE VISIT

The following issues and concerns were listed by the VA team following the site visit:

- The roadway is in a very steep location
- Several stabilization structures have been installed in the project area
- Numerous Redwood trees are present in the area
- Right-of-way is quite narrow in some locations

COST MODEL

The VA team leader prepared a cost model from the designer's cost estimates. The model is organized to identify major construction elements or trade categories, the designer's estimated costs, and the percent of total project cost for the significant cost items.

The cost model clearly showed the cost drivers for the project, and they were used to guide the VA team during the VA Study.

- Structure items represent 81% of the project cost.
- Roadway items represent 9% of the project cost.

SR 101 Roadway Stabilization
Preliminary Cost Estimate Summary

Section	Cost Element	Alt. 2B (adjusted)	% of Total
I.	**ROADWAY ITEMS**		
1.	Earthwork	$540,000	
2.	Traffic Control	$2,000,000	
3.	Class 1 Aggregate Subbase	$115,000	
4.	Class 2 Aggregate Base	$66,500	
5.	Asphalt Concrete	$234,000	
6.	Other Roadway items	$95,000	
	ROADWAY SUBTOTAL	$3,050,500	
	Roadway Markup @ 35%	$1,067,675	
	VA Added Markup	$10,000	
	SUBTOTAL ROADWAY ITEMS	**$4,128,175**	**9.2%**
II.	**STRUCTURE ITEMS**		
1.	Tieback Walls	$26,400,000	
2.	Mobilization @ 10%	$2,640,000	
	SUBTOTAL STRUCTURE ITEMS	**$29,040,000**	
	Structure Markup @ 25%	**$7,260,000**	
	SUBTOTAL STRUCTURES COST	**$36,300,000**	**80.7%**
III.	**ENVIRONMENTAL MITIGATION**		
1.	Environmental Mitigation	$80,000	
	SUBTOTAL ENVIRONMENTAL	**$80,000**	
IV.	**CAPITAL OUTLAY SUPPORT ITEMS**		
1.	Reengineering and Redesign	$4,087,818	
	SUBTOTAL ENVIRONMENTAL	**$4,087,818**	**9.1%**
IV.	**RIGHT OF WAY ITEMS**	$0	
1.	Right-of-Way Acquisition	$370,000	
2.	Residential	$0	
3.	Wetlands (3:1 Replacement)	$0	
4.	Clearing/Removal	$0	
5.	Utility Relocation	$0	
	SUBTOTAL RIGHT OF WAY	**$370,000**	**0.8%**
	TOTAL PROJECT COST	**$44,965,993**	**99.8%**
	USE	**$44,966,000**	

FUNCTION ANALYSIS / FAST DIAGRAM

Function analysis was performed and a Function Analysis System Technique (FAST) Diagram was produced, which revealed the key functional relationships for the project. This analysis provided a greater understanding of the total project and how the issues, project cost, and function requirements are related.

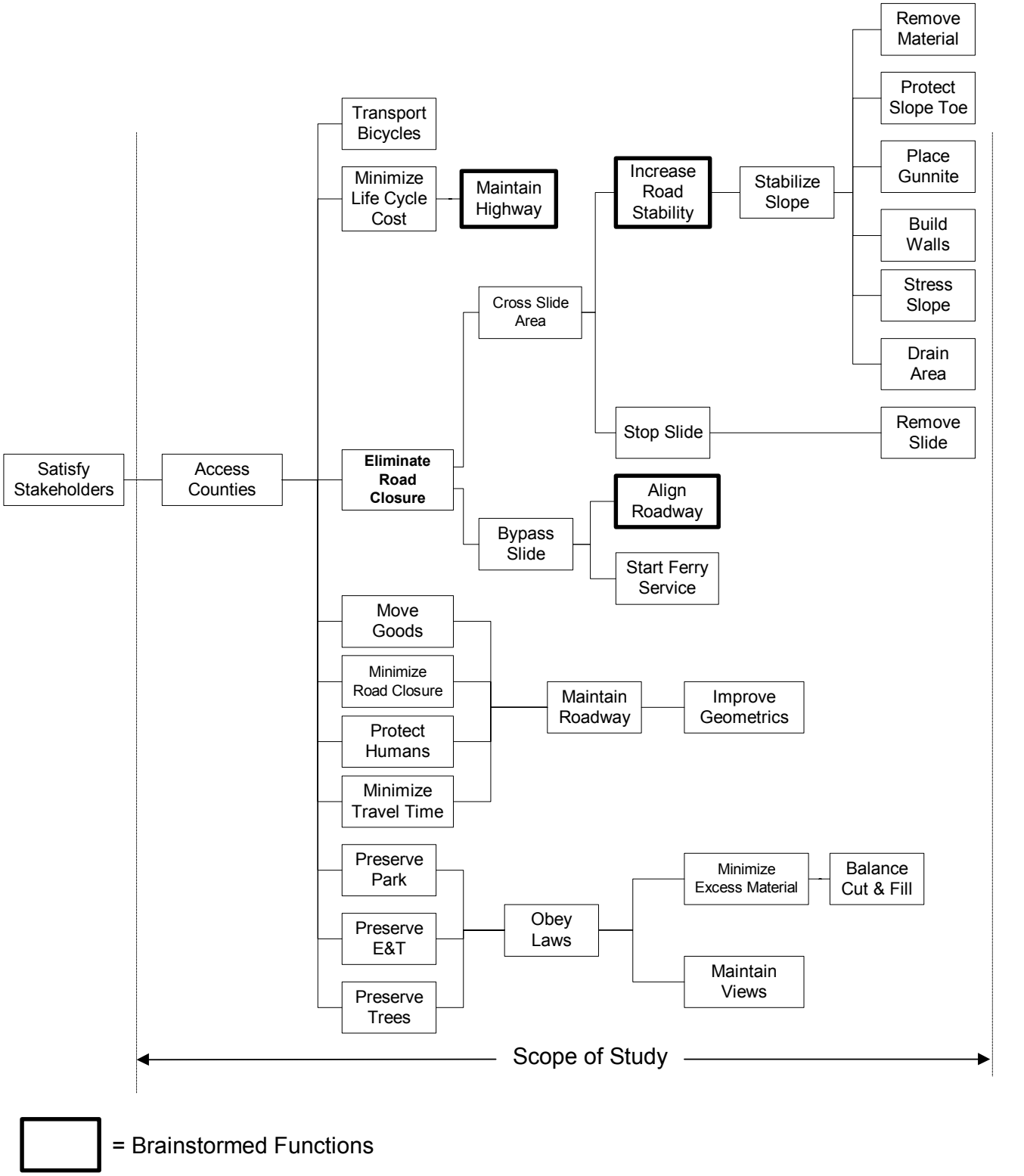
The FAST diagram arranges the functions in logical order so that when read from left to right, the functions answer the question "How?" If the diagram is read from right to left, the functions answer the question "Why?" Functions connected with a vertical line are those that happen at the same time as, or are caused by, the function at the top of the column (a "When?" relationship).

The FAST Diagram for this project shows *Access Counties* as the basic function. Key secondary functions used for brainstorming were *Align Roadway, Increase Road Stability,* and *Maintain Highway*. In several cases the project costs and performance criteria associated with the functions have been identified. This enabled the team to determine the relationship between the project functions and cost, and to confirm that the performance criteria were being satisfied.

Analysis of the functions intended to be performed by the project helped the team focus on the purpose and need of the project and, consequently, how to craft alternative concepts that would provide the required functions.

FUNCTION ANALYSIS SYSTEM TECHNIQUE

SR I01 Road Stabilization
August 2001



= Brainstormed Functions

PERFORMANCE CRITERIA MATRIX

The evaluative criteria matrix was used to determine the key evaluative criteria for the project. The VA team listed, with the assistance of the design team and stakeholders, the possible evaluative criteria that could be used to evaluate the creative ideas. These criteria were entered onto a matrix and compared in pairs, asking the question: "Which one is more important to the project?" The letter code (e.g., "a") was entered into the matrix for each pair. When all pairs were discussed they were tallied and percentages calculated. The highest scoring criteria were selected for use in the Evaluation Phase of the study.

The Performance Criteria Matrix is used to identify the relative importance or weight that the Performance Measures are given in the decision process. Following the Matrix are the definitions of the Performance Measure and the rating scale used for each Performance Measure.

PERFORMANCE CRITERIA MATRIX *SR 101 Roadway Stabilization*	Caltrans

								TOTAL	%
Right-of-Way	**A**	a	a	a	a	a	a	6.0	29%
Constructibility	**B**	b/c	b	b/e	f	g		2.0	10%
Environmental Impacts	**C**	c	c	c	g			3.5	17%
Disposal	**D**	e	f	g				0.0	0%
Aesthetics	**E**	e	g					2.5	12%
Roadway Geometrics	**F**	g						2.0	10%
Maintainability	**G**							5.0	24%

a	More Important
a/b	Equal Importance

21.0	100%

Criteria	Definition	Rating Scale
Right-of-Way	An approximate estimate of the amount of acres needed within park boundaries, the impact on the coastal trail, the impact on memorial groves, and possible Section 4f issues.	10 – Less acreage is needed than the base case 9 – 8 – No additional right-of-way is needed 7 – 6 – Right-of-way needed in base case 5 – Minor additional right-of-way acreage is needed 4 – 3 – Some acreage needed 2 – 1 – Considerable acreage is needed
Maintainability	A measure of the alternative's impact on minimizing the frequency of road closures, the time needed to reopen the road, and deep slide stability.	10 – Significantly improves and eases maintenance activities 9 – 8 – 7 – Slightly improves maintenance access; type of maintenance required no different than for existing facility 6 – Access and type of maintenance required are comparable to existing facility 5 – Slightly degrades maintenance access; type of maintenance required no different than for existing facility 4 – Significantly degrades maintenance access; type of maintenance required no different than for existing facility 3 – Significantly more maintenance than existing facility 2 – Unacceptable access conditions 1 – Cannot be maintained

Environmental Impacts	An approximation of the concept's overall effect on the surrounding environment. This criterion could include the following areas: ♦ Redwood Trees ♦ Habitats ♦ Threatened and Endangered Species	10 – Some enhancement upon existing environmental conditions 9 – Minor improvement upon existing environmental conditions 8 – No environmental impacts 7 – Negligible degradation (does not require mitigation) 6 – Minor degradation (requires limited mitigation) 5 – Moderate degradation (requires significant mitigation in one area or limited mitigation in two) 4 – Moderate degradation (requires significant mitigation in two areas or limited mitigation in three) 3 – Major degradation (requires substantial mitigation in one area and limited/significant mitigation in others) 2 – Major degradation (requires substantial mitigation in two areas and limited/significant mitigation in others) 1 – Severe degradation (requires substantial mitigation in multiple areas)
Aesthetics	A measure of how the concept will affect terrain and ocean views, vegetation, obstructed view travel time for a tunnel.	10 – Some enhancement 9 – 8 – 7 – Little disruption 6 – Maintain present status, some disruption 5 – Minimal or no change in 4 – 3 – 2 – 1 – Considerable undesirable contrast or undesirable visual impacts
Roadway Geometrics	An approximation of how the concept will maintain the existing alignment, and meet truck length and non-motorized traffic needs.	10 – Full compliance 9 – 8 – 7 – 6 – 5 – One major and one minor design exception 4 – 3 – 2 – 1 – Three major and two minor design exceptions

Constructibility	An approximation of the concept's overall effect on construction of the project. This criterion includes the following areas: ♦ Construction Methods ♦ Delays ♦ Traffic Control ♦ Storm Water Drainage	10 – Some improvement over base case standard construction practices, common techniques and equipment used, no traffic delays 9 – 8 – Uses standard construction practices per the base case 7 – 6 – 5 – 4 – Some use of non typical construction practices 3 – Major difficulty in project construction 2 – 1 – Severe construction operations degradation, numerous change orders, complex construction methods and equipment needed, serious road closure events

PERFORMANCE RATING MATRIX

The Performance Rating Matrix compares competing sets of alternatives by applying the weighted performance criteria in a matrix to yield value ratios. VA alternatives are compared to the original concept for the full range of criteria to reach a judgment about their technical feasibility, as well as their acceptability to stakeholders. The matrix is essential for understanding the relationship of cost, performance, and value of the original and VA concepts.

Using the performance criteria developed by the VA team, design team, and stakeholders, the design concepts were ranked on a scale of 1 to 10 and scored by multiplying the weightings. The resulting matrix (see following pages) gives total criteria and value ratio (criteria/cost) numbers.

The VA team, with the assistance of the design team and stakeholders, evaluated the performance of the current project presented in the design documents. The performance ratings for these are indicated on the matrix.

After development of VA alternatives, the VA team evaluated the performance of certain combinations, or sets, of VA alternatives. The results of this evaluation were listed under the baseline to illustrate the relative improvement or degradation to the project performance (compared to the baseline project).

The total performance ratio for each of the sets, as well as the original design, has been totaled and divided by their total costs. The resulting number has been identified as the value index (cost/performance ratio). The net change in the value index between the original design and the VA sets has been identified as a percent value improvement, and the rationale for the ratings is shown below.

The following pages include:

- Rationale for Rating of the Original Concept
- Rationale for Rating – VA Alternative Sets
- Performance Rating Matrix – VA Alternative Sets
- Rationale for Rating – Accepted VA Alternatives
- Performance Rating Matrix – Accepted VA Alternatives

Rationale for Change in Performance and Value – Proposed Alternatives

Performance Criteria	VA Set 1	VA Set 2
Right-of-Way	Would require considerably less potential right-of-way takes than the base case because of one-third less retaining wall length.	Would require approximately one acre of parkland.
Maintainability	Less retaining wall to maintain would be offset by the need for temporary areas to repair/clear slide damage.	Minimal change from the base case.
Environmental Impacts	Considerably less environmental impact than the base case because less area is affected.	Minimal change from the base case.
Aesthetics	Maintaining existing views would be offset by the addition of structures to the area.	Slight reduction from the base case because of the addition of a significant amount of retaining wall.
Roadway Geometrics	Some reduction from the base case because there will be no improvement in the alignments. Some improvement to cyclists' use because of wider shoulder widths.	Slight improvement over the base case because of some increased road width.
Constructibility	A small improvement because one-way traffic would be possible during retaining wall construction.	Some improvement related to one-lane traffic during soil nail wall installation would provide two-lane traffic during tieback wall construction.

PERFORMANCE RATING MATRIX - Proposed Alternatives

SR 101 Roadway Stabilization

Caltrans

Criteria	Unit of Measurement	Criteria Weight	Concept	Performance Rating 1	2	3	4	5	6	7	8	9	10	Total Performance
Right-of-Way	Degree of Impact	29	No Build										10	290
			Baseline				4							116
			VA Set 1								8			232
			Alt B2 Revised					5						145
			Bypass w/Tunnel							7				203
Maintainability	Degree of Impact	24	No Build	1										24
			Baseline						6					144
			VA Set 1					5						120
			Alt B2 Revised						6					144
			Bypass w/Tunnel									9		216
Environmental Impacts	Degree of Impact	17	No Build								8			136
			Baseline			3								51
			VA Set 1									9		153
			Alt B2 Revised						6					102
			Bypass w/Tunnel						6					102
Aesthetics	Degree of Impact	12	No Build					5						60
			Baseline						6					72
			VA Set 1						6					72
			Alt B2 Revised					5						60
			Bypass w/Tunnel						6					72
Roadway Geometrics	Degree of Impact	9	No Build			3								27
			Baseline							7				63
			VA Set 1						6					54
			Alt B2 Revised								8			72
			Bypass w/Tunnel									9		81
Constructibility	Degree of Impact	9	No Build										10	90
			Baseline		2									18
			VA Set 1				4							36
			Alt B2 Revised				4							36
			Bypass w/Tunnel								8			72
														0
														0
														0
														0
														0

OVERALL PERFORMANCE	Total Performance	Total Cost ($ mil)	Value Index (Performance/Cost)	% Value Improvement
No Build	627			
Baseline	464	45	10.31	
VA Set 1	667	6	111.17	978%
Alt B2 Revised	559	36	15.53	51%
Bypass with Tunnel	746	137	5.45	-47%

Rationale for Change in Performance and Value – Accepted Alternatives

Performance Criteria	Accepted VA Alternatives
Right-of-Way	Would require approximately one acre of parkland.
Maintainability	Minimal change from the base case.
Environmental Impacts	Minimal change from the base case.
Aesthetics	Slight reduction from the base case because of the addition of a significant amount of retaining walls.
Roadway Geometrics	Slight improvement over the base case because of some increased road width.
Constructibility	Some improvement related to one-lane traffic during soil nail wall installation would provide two-lane traffic during tieback wall construction.

PERFORMANCE RATING MATRIX - Accepted Alternatives

SR 101 Roadway Stabilization

Caltrans

Criteria	Unit of Measurement	Criteria Weight	Concept	Performance Rating 1	2	3	4	5	6	7	8	9	10	Total Performance
Right-of-Way	Degree of Impact	29	No Build										**10**	290
			Baseline				**4**							116
			Accepted Alt.								**8**			232
Maintainability	Degree of Impact	24	No Build	**1**										24
			Baseline						**6**					144
			Accepted Alt.					**5**						120
Environmental Impacts	Degree of Impact	17	No Build								**8**			136
			Baseline			**3**								51
			Accepted Alt.									**9**		153
Aesthetics	Degree of Impact	12	No Build					**5**						60
			Baseline						**6**					72
			Accepted Alt.						**6**					72
Roadway Geometrics	Degree of Impact	9	No Build			**3**								27
			Baseline							**7**				63
			Accepted Alt.						**6**					54
Constructibility	Degree of Impact	9	No Build										**10**	90
			Baseline		**2**									18
			Accepted Alt.				**4**							36

OVERALL PERFORMANCE	Total Performance	Total Cost ($ mil)	Value Index (Performance/ Cost)	% Value Improvement
No Build	627			
Baseline	464	45	10.31	
Accepted VA Alternative 2.0	667	6	111.17	978%

Project Description

PROJECT DESCRIPTION

INTRODUCTION

The purpose of this project is to identify and propose recommendations to mitigate operational deficiencies currently experienced on SR 101 from PM 15.0 to 15.6. The purpose was also to consider deficiencies experienced in the longer segment from PM 12.5 to 15.6. The proposed work is required to assure that the roadway will remain open to vehicular traffic. The project was initiated as a result of joint concerns of Caltrans, the Del Norte County Transportation Commission, and the public. The proposed project would be funded under the HA42 (Protective Betterment) Program.

SR 101 is a major transportation route of interregional and interstate importance. It is considered the "lifeline" of the North Coast, providing the connection between the Northern California Coast and the populated San Francisco Bay Area to the south and Oregon to the north. SR 101 facilitates many important types of transportation, including tourism, emergency services, and transportation of goods to, from, and through the region. It is part of the National Highway System and is specified by ISTEA; it is also part of the Subsystem of Highways for Extra Legal Loads.

This segment of SR 101 has historically required significant maintenance efforts to avoid road closure. The longer segment (PM 12.5 to 15.6) has been subject to traffic control for approximately 1,000 hours per year (12% of the time) over the past 10 years. One road closure in the early 1970's claimed two lives. The District has expended an average of $60,000 per year (average of 1991 to1995). During wet conditions, overnight settlement occurs, requiring inspection and sometimes repair of the roadway. The long-term results of the settlement are poor vertical alignment and a rough ride for the traveling public. The segment of the roadway in the project length (15.0 to 15.6) requires night monitoring during wet weather to provide timely response to abrupt settlement. It is anticipated that maintenance expenditures and the likelihood of another roadway closure would increase over time.

The section of SR 101 proposed for reconstruction is two-lane conventional highway with 3.66-meter (12-foot) wide lanes, and alignment is generally curvilinear. Vertical alignment is rolling, with a maximum grade of approximately 7%. The existing and future (2010) level of service is E.

This section of SR 101 was constructed on the west-facing flank of a 300-meter high (1,000-foot) ridge, bounded on the west by the Pacific Ocean and on the east by Wilson Creek. The project is surrounded by the Del Norte Coast Redwoods State Park boundaries. Existing right-of-way widths vary through out the project site.

PROJECT HISTORY

Stabilizing the roadway at Last Chance Grade (between PM 15.0 and 15.6) is a major project, which is expected to cost more than $750,000. Projects exceeding $750,000 are eligible for programming in the State Highway Operations and Protection Program (SHOPP). A SHOPP project can be rehabilitation, a protective betterment, or an operational improvement; it cannot be capacity increasing or a new facility. Capacity increasing and/or new facilities projects are eligible for programming in the State Transportation Improvement Program (STIP).

The original project encompassing the location at Last Chance Grade was referred to as the "Wilson Creek Bluffs" project and was initiated in 1987 to address nine areas of identified roadway instability. This project studied bypass alternatives between PM 12.5 and 16.5. An eastern bypass alternative was programmed in the 1992 STIP as a "long lead", not including construction funding. This was due in part to impacts to parklands and to old growth trees, and lack of support from regulatory agencies and conservancy groups. This project was un-programmed in 1993.

A Corridor Study on SR 101 was initiated following programming of the Wilson Creek Bluffs project in the 1992 STIP. The Corridor Study considered all of SR 101, but it focused primarily on the section from PM 12.5 to 22.5. This study considered the accumulative impacts to parklands and old growth trees from both the Wilson Creek Bluffs project and a separate bypass project being studied at Cushing Creek (between PM 20.5 and 22.5). The Corridor Study identified an alternative that would avoid all parklands. This alternative was determined to consist of a 17-mile bypass with a cost of $580 million. Based upon the results of this study, the Wilson Creek Bluffs project was removed from the 1992 STIP (unprogrammed), and it was proposed to study SHOPP projects within the existing alignment that would address stabilizing the roadway. The section of SR 101 at Last Chance Grade was considered the highest priority due to the slide complex containing five of the nine unstable areas. Studies to address this area were initiated in 1993, and a Project Study Report was completed in February 1995.

The current PSR for this project was approved in February 1995. It is classified as a long-lead SHOPP project. It has four alternatives: (1) Realignment of the highway in a tunnel behind the slide plane; (2A) Minor roadway realignment with soldier pile tieback wall and slope stressing for stabilization; (2B) Minor roadway realignment with two soldier pile tieback walls for stabilization; and (3) A major retreat behind the slide plane. In an effort to ensure that the alternatives were feasible, a geotechnical study was initiated in mid-1998. Actual field investigations and engineering analyses were performed in 1999 and 2000. A final Geotechnical Report was prepared in May 2001. The geotechnical report concluded that the PSR Alternative 3, the major retreat, was the only alternative that could be expected to successfully address the deep-seated slide. Unfortunately, the impacts to parklands would be unacceptable.

The estimated project cost of the baseline PSR Alternative 2B, Minor roadway realignment and two shoulder pile tieback walls for stabilization is estimated at approximately $45,000,000.

INFORMATION PROVIDED TO THE VA TEAM

The following documents were provided to the VA team for their use during the study:

- Project Study Report (01-DN-101-15.0/15.6) February 1995
- Preliminary Geotechnical Report, California Department of Transportation, May 31, 2001
- Aerial Photographs of the project area
- Other drawings and technical materials prepared by Caltrans

PROJECT CONSTRAINTS / PARADIGM SHIFTS

The following items were identified and addressed by the VA team:

- Stay within the Caltrans right-of-way
- Avoid impacts to trees
- Roadway maintainability
- Funding constrains are important to Caltrans
- Short- and long-term roadway stabilization issues

Idea Evaluation

IDEA EVALUATION

INTRODUCTION

The creative ideas generated by the VA team are carefully evaluated, and project-specific criteria are applied to each idea to assure an objective evaluation.

KEY EVALUATIVE CRITERIA

The VA team used the paired comparison method to prioritize the key evaluative criteria for this project:

- Right-of-Way
- Maintainability
- Environmental Impact
- Aesthetics
- Roadway Geometrics
- Constructibility

The team enlisted the assistance of the stakeholders and designers (when available) to develop these criteria so that the evaluation would reflect their specific requirements.

EVALUATION PROCESS

The VA team, as a group, generated and evaluated ideas on how to perform the various functions. The idea list was grouped by function. While ideas on the overall project were evaluated as a group, ideas relating to a specific technical discipline may have been evaluated by the responsible team member.

The team compared each of the ideas with the original concept for each of the key evaluative criteria to determine whether it was better than, equal to, or worse than the original concept. The team reached a consensus on the ranking of the idea. High-ranked ideas would be developed further; low-ranked ones would be dropped from further consideration.

IDEA EVALUATION FORMS

All of the ideas that were generated during the creative phase using brainstorming techniques were recorded on the following Idea Evaluation forms. These ideas were discussed and the advantages and disadvantages of each were listed.

IDEA EVALUATION *SR 101 Roadway Stabilization*									Caltrans		
Ideas		**Performance Criteria**						**Advantages**	**Disadvantages**	**$**	**Rank**
No.	**ALIGN ROADWAY**	**R**	**M**	**E**	**A**	**G**	**C**				
AR-1	Through cut from PM 14.5 to 15.5	-2	+1	-2	-2	+1	+1	♦ Built on stable ground ♦ Increases ocean retreat buffer ♦ Can be built with conventional equipment and techniques ♦ Provides more opportunities for vista points ♦ Minimizes closures and delays during construction	♦ Removes 275 old growth redwoods ♦ Requires high T&E mitigation costs ♦ Significant disposal issues and costs ♦ Requires significant parkland	-	4/3
AR-2	Construct 6,000-foot tunnel	-1	0	-1	+1	+1	-1	♦ Improves aesthetics ♦ Improves horizontal and vertical geometrics ♦ Minimizes tree impacts	♦ Risk of catastrophic failure is not completely eliminated ♦ Substantial maintenance costs ♦ Increases possibility of road closures due to accidents ♦ Substantial disposal of material ♦ Difficult construction	- -	3

Ranking Scale: **5 = Cost and Performance Improvement** **4 = Cost or Performance Improvement** **3 = Minor Improvements**
2 = Cost and Performance Reduction **1 = Does not Meet Project Purpose and Need** **OS = Outside Project Scope**

Evaluation Criteria: **Significant Improvement +2, +1, 0, -1, -2 Significant Degradation** **I/S = in Baseline Scope** **NR = Not Rated**

R = Right-of-Way **M = Maintainability** **E = Environmental Impacts** **A = Aesthetics** **G = Geometrics** **C = Constructibility**

IDEA EVALUATION *SR 101 Roadway Stabilization*									Caltrans		
Ideas		Performance Criteria						Advantages	Disadvantages	$	Rank
No.	ALIGN ROADWAY	R	M	E	A	G	C				
AR-3	Use a Wilson Creek Alignment	-2	+1	-2	0	+2	+2	♦ Improves roadway geometrics ♦ Built on stable ground ♦ Constructed with conventional methods with balanced cut and fill ♦ Out of present corridor ♦ Possible reuse of SR 101	♦ Difficult SWPPP ♦ Goes through parkland with substantial impacts to trees and T & E	-	OS 4/1
AR-4	Put road on the top of the hill toward the east	-2	+1	-2	+1	-2	+1	♦ Built on stable ground	♦ Steep grade ♦ Outside right-of-way ♦ Numerous trees ♦ T&E	-	OS 3
AR-5	Realign to the west, using side hill cut and fill								♦ Technically and physically infeasible		NR
AR-6	Realign to the west, using a viaduct								♦ Financially, technically, and physically infeasible		NR
AR-7	Suspension bridge over the slide area								♦ Financially, technically, and physically infeasible		NR

Ranking Scale: **5 = Cost and Performance Improvement** **4 = Cost or Performance Improvement** **3 = Minor Improvements**
2 = Cost and Performance Reduction **1 = Does not Meet Project Purpose and Need** **OS = Outside Project Scope**

Evaluation Criteria: **Significant Improvement +2, +1, 0, -1, -2 Significant Degradation** **I/S = in Baseline Scope** **NR = Not Rated**

R = Right-of-Way **M = Maintainability** **E = Environmental Impacts** **A = Aesthetics** **G = Geometrics** **C = Constructibility**

IDEA EVALUATION *SR 101 Roadway Stabilization*											Caltrans	
Ideas		**Performance Criteria**						**Advantages**	**Disadvantages**	**$**	**Rank**
No.	**ALIGN ROADWAY**	**R**	**M**	**E**	**A**	**G**	**C**				
AR-8	Realign roadway using retaining walls within right-of-way (Alternative 2B in 1995 PSR)	0	+1	0	0	+1	-1	♦ Does not take trees ♦ Improves vertical and horizontal alignment	♦ Traffic delays ♦ Chance of failure during construction ♦ Does not stabilize the deep slide	-	4
AR-9	Install a tramway								♦ Impractical		NR
AR-10	Construct stacked roadways								♦ Impractical and technically infeasible		NR
AR-11	Construct 6,000-foot twin long tunnels	-1	0	-1	+1	+1	0	♦ Redundant tunnel for emergencies ♦ Prevents head-on collisions	♦ Risk of catastrophic failure is not completely eliminated ♦ Substantial maintenance costs ♦ Increases possibility of road closures due to accidents ♦ Substantial disposal of material	- -	OS 3
AR-12	Realign roadway using retaining walls and slope stressing (Alternative 2A from 1995 PSR)	-2	+1	-2	-1	+1	-1	♦ Improves vertical and horizontal alignment ♦ Improves the factor of safety for uphill shallow slides ♦ Maintains ocean views	♦ Impact to trees	-	OS 3

Ranking Scale: **5 = Cost and Performance Improvement** **4 = Cost or Performance Improvement** **3 = Minor Improvements**
2 = Cost and Performance Reduction **1 = Does not Meet Project Purpose and Need** **OS = Outside Project Scope**

Evaluation Criteria: **Significant Improvement +2, +1, 0, -1, -2 Significant Degradation** **I/S = in Baseline Scope** **NR = Not Rated**

R = Right-of-Way **M = Maintainability** **E = Environmental Impacts** **A = Aesthetics** **G = Geometrics** **C = Constructibility**

IDEA EVALUATION *SR 101 Roadway Stabilization*									Caltrans		
Ideas		Performance Criteria						Advantages	Disadvantages	$	Rank
No.	ALIGN ROADWAY	R	M	E	A	G	C				
AR-13	Construct a cut and cover tunnel								♦ Technically infeasible		NR
AR-14	Install anchors attached to the reverse slope of the east hill to help support the roadway								♦ Technically infeasible		NR
AR-15	Use Wilson Creek Bypass alignment with a tunnel under the park	-2	+1	-2	0	+1		♦ Bypasses the unstable area ♦ Improves roadway geometrics ♦ Built on stable ground ♦ Constructed with conventional methods with balanced cut and fill ♦ Out of present corridor ♦ Possible reuse of SR 101 for Pacific Coast beneficiation	♦ Needs right-of-way	- -	OS 3
AR-16	Construct a Wilson Creek to Enders Beach Jetty with a road on top	0	0	0	0	0			♦ Financially impractical		NR
AR-17	Install Bart-type tunnel								♦ Impractical		NR
AR-18	Install avalanche-type debris sheds	0	0	0	0	0			♦ Does not meet purpose and need		NR

Ranking Scale: **5 = Cost and Performance Improvement** **4 = Cost or Performance Improvement** **3 = Minor Improvements**
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Evaluation Criteria: **Significant Improvement +2, +1, 0, -1, -2 Significant Degradation** **I/S = in Baseline Scope** **NR = Not Rated**

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IDEA EVALUATION *SR 101 Roadway Stabilization*									Caltrans		
Ideas		**Performance Criteria**						**Advantages**	**Disadvantages**	**$**	**Rank**
No.	**ALIGN ROADWAY**	**R**	**M**	**E**	**A**	**G**	**C**				
AR-19	Install flexible wooden plank roadway								♦ Impractical		NR
AR-20	Install single-lane roadway with traffic control	+2	+1	0	+1	+1	+1	♦ Maintains roadway as is ♦ Creates wide shoulders ♦ Possibly easier implemented maintenance	♦ Does not meet purpose and need – does not improve stability ♦ Reduces roadway capacity ♦ Politically unacceptable	++	1
AR-21	Install a pontoon-style bridge								♦ Impractical		NR
AR-22	Construct a South Fork Road bypass								♦ Does not meet purpose and need ♦ Goes through Redwood National Park		NR
AR-23	Use the Simpson Timber land for a bypass with a viaduct	-2	+2	-2	+1	+2	+2	♦ Avoids unstable area ♦ May open new vistas ♦ Conventional construction	♦ Takes some trees ♦ Does not meet purpose and need	-	OS 4

Ranking Scale: **5 = Cost and Performance Improvement** **4 = Cost or Performance Improvement** **3 = Minor Improvements**
2 = Cost and Performance Reduction **1 = Does not Meet Project Purpose and Need** **OS = Outside Project Scope**

Evaluation Criteria: **Significant Improvement +2, +1, 0, -1, -2 Significant Degradation** **I/S = in Baseline Scope** **NR = Not Rated**

R = Right-of-Way **M = Maintainability** **E = Environmental Impacts** **A = Aesthetics** **G = Geometrics** **C = Constructibility**

IDEA EVALUATION *SR 101 Roadway Stabilization*										Caltrans		
Ideas		**Performance Criteria**						**Advantages**	**Disadvantages**	**$**	**Rank**
No.	**INCREASE STABILIZATION**	**R**	**M**	**E**	**A**	**G**	**C**				
IS-1	Install horizontal water drains							♦ See IS-11			-
IS-2	Plant trees								♦ Does not meet purpose and need	--	NR
IS-3	Cut slope back to 2:1 toward the east without realignment	-2	0	-2	-2	+1	-2	♦ Some improvement in stability on the deep slide	♦ Significant tree removal ♦ Large disposal of excess ♦ Right-of-way impacts	-	OS3
IS-4	Remove and reengineer fill								♦ Requires lengthy road closure during construction		NR
IS-5	Use slope stressing uphill and downhill with some curve correction (used in combination with other slope stabilization measures; possible research funding)	-2	+1	-1	-1	+1	-1	♦ Significant stability improvement ♦ Stays in existing alignment	♦ Construction outside the right-of-way ♦ Unproven at this scale ♦ Takes trees	-	OS 4
IS-6	Install “dolos” to stabilize toe of the slope with or without a buttress (combine with other measures)							♦ See IS-24	♦ Impractical		-

Ranking Scale: **5 = Cost and Performance Improvement** **4 = Cost or Performance Improvement** **3 = Minor Improvements**
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Evaluation Criteria: **Significant Improvement +2, +1, 0, -1, -2 Significant Degradation** **I/S = in Baseline Scope** **NR = Not Rated**

R = Right-of-Way **M = Maintainability** **E = Environmental Impacts** **A = Aesthetics** **G = Geometrics** **C = Constructibility**

IDEA EVALUATION *SR 101 Roadway Stabilization*									Caltrans		
Ideas		Performance Criteria						Advantages	Disadvantages	$	Rank
No.	INCREASE STABILIZATION	R	M	E	A	G	C				
IS-7	Gunnite slopes							♦ See IS-11			-
IS-8	Install retaining walls that go past the deep slip plane								♦ Physically impracticable to construct to withstand forces related to the deep slide		NR
IS-9	Build a seawall							♦ See IS-6			-
IS-10	Use injection grouting								♦ Does not meet purpose and need		NR
IS-11	Install a major subterranean drainage system (this idea will be used in conjunction with other drainage ideas)								♦ Difficult to collect the water		NR
IS-12	Install deep under drains							♦ See IS-11			-
IS-13	Install slope drainage galleries							♦ See IS-11			-
IS-14	Install top to bottom drainage system							♦ See IS-11			-

Ranking Scale: **5 = Cost and Performance Improvement** **4 = Cost or Performance Improvement** **3 = Minor Improvements**
2 = Cost and Performance Reduction **1 = Does not Meet Project Purpose and Need** **OS = Outside Project Scope**

Evaluation Criteria: **Significant Improvement +2, +1, 0, -1, -2 Significant Degradation** **I/S = in Baseline Scope** **NR = Not Rated**

R = Right-of-Way **M = Maintainability** **E = Environmental Impacts** **A = Aesthetics** **G = Geometrics** **C = Constructibility**

IDEA EVALUATION *SR 101 Roadway Stabilization*										Caltrans		
Ideas		**Performance Criteria**						**Advantages**	**Disadvantages**	**$**	**Rank**
No.	**INCREASE STABILIZATION**	**R**	**M**	**E**	**A**	**G**	**C**				
IS-15	Shotcrete slopes as needed							♦ See IS-11			-
IS-16	Retaining walls at the toe of the slope							♦ See IS-6			-
IS-17	Use maintenance walls that do not penetrate the deep slip plane	0	+1	0	0	+1	-1	♦ Does not take trees ♦ Improved vertical and horizontal alignment ♦ Fundable	♦ Traffic Delays ♦ Chance of failure during construction ♦ Does not stabilize the deep slide	+ +	4/3
IS-18	Remove slide and rebuild on stable ground							♦ See IS-3	♦ Impossible to construct		-
IS-19	Install soil cement caissons with “H” piles								♦ Technically infeasible		
IS-20	Bench into the slope with realignment from top to bottom	-2	+1	-2	-2	+1	-2	♦ Improves stability ♦ Reduces storm slide material	♦ Takes many trees ♦ Significant right-of-way takes ♦ Denudes the landscape	-	OS 3
IS-21	Use lightweight fill or tire stabilization system							♦ See IS-17			-

Ranking Scale: **5 = Cost and Performance Improvement** **4 = Cost or Performance Improvement** **3 = Minor Improvements**
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Evaluation Criteria: **Significant Improvement +2, +1, 0, -1, -2 Significant Degradation** **I/S = in Baseline Scope** **NR = Not Rated**

R = Right-of-Way **M = Maintainability** **E = Environmental Impacts** **A = Aesthetics** **G = Geometrics** **C = Constructibility**

IDEA EVALUATION *SR 101 Roadway Stabilization*										Caltrans		
Ideas		**Performance Criteria**						**Advantages**	**Disadvantages**	**$**	**Rank**
No.	**INCREASE STABILIZATION**	**R**	**M**	**E**	**A**	**G**	**C**				
IS-22	Pour continuous slab on top of present pavement with grout port							♦ See IS-17	♦ Does not resist the horizontal slide component		-
IS-23	Build a large buttress fill in the ocean and fill in with disposal material							♦ See IS-6			-
IS-24	Implement slope stabilization with various techniques (drainage, slope stressing, gunnite, reinforcing of toe of slope)	-2	+1	-2	-1	+1	-1	♦ Improves stability ♦ Increases project/facility life	♦ Constructibility ♦ Significant aesthetic and environmental impact	--	OS 3

Ranking Scale:	**5 = Cost and Performance Improvement**	**4 = Cost or Performance Improvement**	**3 = Minor Improvements**		
	2 = Cost and Performance Reduction	**1 = Does not Meet Project Purpose and Need**	**OS = Outside Project Scope**		
Evaluation Criteria:	**Significant Improvement +2, +1, 0, -1, -2 Significant Degradation**		**I/S = in Baseline Scope**	**NR = Not Rated**	
R = Right-of-Way	**M = Maintainability**	**E = Environmental Impacts**	**A = Aesthetics**	**G = Geometrics**	**C = Constructibility**

IDEA EVALUATION *SR 101 Roadway Stabilization*										Caltrans		
Ideas		**Performance Criteria**						**Advantages**	**Disadvantages**	**$**	**Rank**
No.	**MAINTAIN HIGHWAY**	**R**	**M**	**E**	**A**	**G**	**C**				
MH 1	No build; keep present maintenance program only	0	0	0	0	0	0	♦ No right-of-way takes ♦ Minimizes short-term costs	♦ Occasional road closures ♦ Does not meet purpose and need	++	1
MH 2	Use phased approach to install upgrades and test how well they work (a possible method to employ an option)										NR
MH 3	Continue low-level maintenance without walls							♦ See C-1			-
MH 4	Continue low-level maintenance and develop a contingency plan for a catastrophic event (outside scope and suggested follow-on alternative)							♦ See C-1 ♦ Reopen time should be minimized ♦ Minimize materials procurement time ♦ Early contact with stakeholders			-
MH 5	Install toll roads to fund improvements								♦ Administratively not legal, no parallel public road		NR

Ranking Scale: **5 = Cost and Performance Improvement** **4 = Cost or Performance Improvement** **3 = Minor Improvements**
2 = Cost and Performance Reduction **1 = Does not Meet Project Purpose and Need** **OS = Outside Project Scope**

Evaluation Criteria: **Significant Improvement +2, +1, 0, -1, -2 Significant Degradation** **I/S = in Baseline Scope** **NR = Not Rated**

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IDEA EVALUATION *SR 101 Roadway Stabilization*									Caltrans		
Ideas		Performance Criteria						Advantages	Disadvantages	$	Rank
No.	MAINTAIN HIGHWAY	R	M	E	A	G	C				
MH 6	Lobby legislature deauthorize part of the park										

Ranking Scale:	**5 = Cost and Performance Improvement**	**4 = Cost or Performance Improvement**	**3 = Minor Improvements**		
	2 = Cost and Performance Reduction	**1 = Does not Meet Project Purpose and Need**	**OS = Outside Project Scope**		
Evaluation Criteria:	**Significant Improvement +2, +1, 0, -1, -2 Significant Degradation**		**I/S = in Baseline Scope**	**NR = Not Rated**	
R = Right-of-Way	**M = Maintainability**	**E = Environmental Impacts**	**A = Aesthetics**	**G = Geometrics**	**C = Constructibility**

Value Analysis Process

VALUE ANALYSIS PROCESS

INTRODUCTION

The Value Analysis process involves fifteen activities needed to accomplish a VA study, organized in three parts: Preparation, VA Study, and Report.

PREPARATION

Prior to the start of a VA study, the District VA Coordinator (DVAC) and Team Leader carry out the following three activities:

- **Initiate Study** – Identify study project; define study goals; prepare draft study charter and Task Order Initiation Document.
- **Organize Study** – Conduct preparation meeting; select team members; finalize study charter and Task Order Initiation Document.
- **Prepare Data** – Collect and distribute data; prepare cost models; develop LCC model.

All of the information gathered prior to the VA Study is given to the team members for their use.

VA STUDY

There are ten activities carried out by the VA team during the performance of the study, organized in three segments:

Segment 1

- **Inform Team** – Receive designer presentation; visit project site; develop performance criteria, evaluate baseline design.
- **Analyze Functions** – Identify basic functions and cost drivers; prepare FAST diagram.
- **Create Ideas** – List a large quantity of alternative ideas; use group/individual brainstorming.
- **Evaluate Ideas** – Evaluate all ideas against performance criteria; rank all ideas.

Segment 2

- **Develop Alternatives** – Develop high-ranked ideas into VA alternatives; measure performance.
- **Critique Alternatives** – Review grouped alternatives for team consensus, technical viability.
- **Present Alternatives** – Give informal presentation of alternatives; prepare preliminary report.

Segment 3

- **Assess Alternatives** – Review alternatives; prepare draft implementation decisions.
- **Resolve Alternatives** – Resolve dispositions; edit and revise alternatives; summarize results.
- **Present Results** – Give formal presentation of accepted alternatives.

REPORT

Following the VA study, the Team Leader assembles all study documentation into the final report:

- **Publish Results** – Prepare Final VA Study Report; distribute printed and electronic copies.
- **Close-Out Study** – Resolve conditionally accepted alternatives; finalize VA Study Summary Report and performance measures; update Executive Summary and publish electronically.

The VA study is complete when the report is issued as a record of the VA team's analysis and development work, as well as the project development team's implementation dispositions for the alternatives.

Performance measures are integral to the VA process and are used throughout the VA Study. The following detailed discussion of the performance measures provides better clarification of how they are used within the VA process. A VA Activity Chart, which outlines the fifteen VA activities in more detail, follows the performance measures. The VA Study Agenda and Meeting Attendees sheet, which document the schedule and participants in the VA Study, are at the end of this section.

Caltrans VA Study Process

PREPARATION

INITIATE STUDY (1)
- Identify study project
- Define study goals
- Identify study roles and responsibilities
- Identify study dates and logistics
- Begin recruitment of team members
- Select Team Leader
- Prepare draft study charter

ORGANIZE STUDY (2)
- Conduct pre-study meeting:
- Identify stakeholders, decision makers, and technical reviewers
- Validate team member qualifications and finalize selection
- Identify data collection
- Finalize study dates and logistics
- Update VA Study Charter

PREPARE DATA (3)
- Collect and distribute data
- Develop construction cost models
- Develop highway user benefit LCC model

VA STUDY

Segment 1

INFORM TEAM (4)
- Review study activities and confirm reviewers
- Present design concept
- Present stakeholders' interests
- Review project issues and objectives
- Identify key functions and performance criteria
- Visit project site

ANALYZE FUNCTIONS (5)
- Analyze project data
- Expand project functions
- Prepare FAST diagram
- Determine functional cost and performance drivers

CREATE IDEAS (6)
- Focus on functions
- List all ideas
- Apply creativity and innovation techniques (group and individual)

EVALUATE IDEAS (7)
- Apply key performance criteria
- Rate each idea
- List advantages and disadvantages
- Rank all ideas
- Assign alternatives for development

Segment 2

DEVELOP ALTERNATIVES (8)
- Develop alternative concepts
- Prepare sketches and calculations
- Measure performance
- Estimate costs, LCC benefits/costs

CRITIQUE ALTERNATIVES (9)
- VA Alternatives Technical Review
- VA Alternatives Team Consensus Review
- Update and reevaluate functions and performance measures (if necessary)
- Group and number alternatives
- Validate performance

PRESENT ALTERNATIVES* (10)
- Present findings
- Validate performance measure changes, if necessary
- Document feedback
- Confirm pending reviews
- Prepare preliminary report

* *Interim presentation of study finding*

Segment 3

ASSESS ALTERNATIVES** (11)
- Review preliminary report
- Assess alternatives for project acceptance
- Prepare draft implementation dispositions

** *Activities performed by PDT, Technical Reviewers, and Stakeholders*

RESOLVE ALTERNATIVES (12)
- Review implementation dispositions
- Resolve implementation actions with decision-makers and stakeholders
- Edit alternatives
- Revisit rejected alternatives, if needed

PRESENT RESULTS* (13)
- Present results
- Obtain management approval on implemented alternatives
- Summarize performance, cost, and value improvements

* *Final presentation of study results*

REPORT

PUBLISH RESULTS (14)
- Document process and study results
- Incorporate all comments and implementation actions
- Distribute Final VA Report
- Distribute electronic report to HQ VA Branch
- Update VA Study Summary Report (VASSR)
- Provide HQ the Final VA Report in pdf format

CLOSE-OUT STUDY (15)
(if Conditionally Accepted Alternatives exist)
- Resolve Conditionally Accepted Alternatives
- Finalize VA Study Summary Report (VASSR)
- Finalize Performance Measures
- Finalize VA Report Executive Summary and provide electronically to HQ

CALTRANS VA PERFORMANCE METHODOLOGY

INTRODUCTION

Performance measures are an integral part of the Caltrans VA Process. It is important that they are well defined and agreed to by the stakeholders at the start of the VA Study, as they are used throughout the study to identify, evaluate, and document alternatives. They are used to report performance improvement at the conclusion of the study. The primary goal of Value Analysis is to improve project value. A simple way to think of value in terms of an equation is as follows:

Value = Performance ÷ Cost

Value analysis has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, oftentimes at the expense of overlooking the role that VA can play with regard to improving project performance. Project costs are fairly easy to quantify and compare through traditional estimating techniques. Performance is not so easily quantifiable.

The Caltrans VA Program has developed a unique methodology using a variety of techniques aimed at identifying, defining, and quantifying performance. Once this has been accomplished, the interrelationship between cost and performance can be quantified and compared in terms of how they contribute to overall value.

The direct and active involvement of the project's stakeholders is at the core of this process. The VA Team Leader will lead Caltrans and external stakeholders through the methodology, using the power of the process to distill subjective thought into an objective language that everyone can relate to and understand. The dialog that develops then forms the basis for the VA team's understanding of the performance requirements of the project, and to what degree the current design concept is meeting those requirements. From this baseline, the VA team can focus on developing alternative concepts that will quantify both performance and cost and contribute to overall project value.

The Caltrans approach to project performance yields the following benefits:

- Builds consensus among project stakeholders (especially those holding conflicting views)
- Develops a better understanding of a project's goals and objectives
- Develops a baseline understanding of how the project is meeting performance goals and objectives
- Identifies areas where project performance can be improved through the VA process
- Develops a better understanding of a VA alternative's effect on project performance
- Develops an understanding of the relationship between performance and cost in determining value
- Uses value as the basis of selecting the right project or design concept
- Provides decision makers with a means of comparing costs and performance (i.e., costs vs. benefits) in a way that can assist them in making better decisions.

METHODOLOGY

Application of the performance methodology consists of the following steps:

1) Define the major performance criteria
2) Determine the relative importance of the criteria
3) Establish the performance "baseline" for the original design
4) Evaluate the performance of the VA alternative concepts
5) Compare the performance ratings of alternative concepts to the "baseline" project

Step 1 – Determine the Major Performance Criteria

The VA Team Leader will initially request that representatives from Caltrans and external stakeholders identify the performance criteria that they feel are essential to meeting the overall need and purpose of the project. Usually four to eight criteria are selected. It is important that all potential criteria be thoroughly discussed. The information that comes out of this discussion will be valuable to both the VA team and Caltrans. It is important that the criteria be discretely defined and be quantifiable in some form. By quantifiable, it is meant that a useable scale must be delineated with values given on a scale of 1 to 10. A "1" indicates poor value, while a "10" indicates excellent value. In most cases, the vast majority of performance criteria that typically appear in Caltrans VA Studies have been standardized. This standardized list may be used "as is," or adopted with minor adjustments as required. Every effort should be made to make the ratings as objective as possible.

Step 2 – Determine the Relative Importance of the Criteria

Once the group has agreed upon the project's performance criteria, the next step is to determine their relative importance in relation to each other. This is accomplished through the use of an evaluative tool termed "Performance Criteria Matrix." This matrix compares the performance criteria in pairs, asking the question: "Which one is more important to the project?" A letter code (e.g., "a") is entered into the matrix for each pair, identifying which of the two is more important. If a pair of criteria is considered to be of essentially equal importance, both letters (e.g., "a/b") are entered into the appropriate box. This, however, should be discouraged, as it has been found that in practice a tie usually indicates that the pairs have not been adequately discussed. When all pairs have been discussed, the number of "votes" for each criterion is tallied and percentages (which will be used as weighted multipliers later in the process) are calculated. It is not uncommon for one criterion to not receive any "votes." If this occurs, the criterion is given a token "vote", as it made the list in the first place and should be given some degree of importance.

It is important for the VA Team Leader to remind the group that, as they evaluate each pair of criteria, they should think of performance trade-offs in hypothetical terms as they relate to the project's overall need and purpose. For instance, the VA Team Leader might state, "If we were considering a concept that would improve mainline operations, but at the expense of reducing access between the freeway and local streets, which criterion would be more critical in meeting the project's intended need and purpose?" The team should also be reminded that these performance criteria will be used to evaluate the merits of alternative concepts generated during the course of the VA Study. As such, the group should keep an open mind and base their evaluation on what is possible rather than what exists in terms of the current design concept.

Step 3 – Establish the Performance "Baseline" for the Original Design

The next step in the process is to evaluate how well the original design is addressing the project's performance criteria. This step establishes a "baseline" against which the VA alternative concepts are compared. The Performance Rating Matrix is used to assist the VA team in determining the performance ratings for the original design concept. The representatives from the Caltrans design team and external stakeholders next begin assigning a 1 to 10 rating for each of the criteria, using the definitions and scales developed in Step 1.

Once the 1 to 10 ratings for the various criteria have been established, their total performance should be calculated by multiplying each criterion's weight (which was developed in Step 2) by its rating. Once the total performance for each criterion has been determined, the original design's total performance is calculated by adding the scores for all of the criteria. The concept's total performance will be somewhere between 100 and 1,000 points. A concept scoring 1,000 would represent a hypothetically "perfect" design concept, with all performance criteria being addressed to their theoretical maximum. This numerical expression of the original design's performance forms the "baseline" against which all alternative concepts will be compared.

Step 4 – Evaluate the Performance of the VA Alternative Concepts

Once the performance baseline has been established for the original design concept, it is used to help the VA team develop performance ratings for individual VA alternative concepts as they are developed during the course of the VA study. The Performance Measures form is used to capture this information as alternative concepts are developed. This form allows a side-by-side comparison of the original design and VA alternative concepts to be performed.

It is important to consider the alternative concept's impact on the entire project, rather than on discrete components, when developing performance ratings for the alternative concept

Step 5 - Compare the Performance Ratings of Alternative Concepts to the "Baseline" Project

The last step in the process completes the Performance Rating Matrix that was initially used to develop the performance ratings for the original design concept. Using the same process as described for rating the original concept, the performance ratings developed for the VA alternative concepts are entered into the matrix, and the summary portion of the Performance Rating Matrix is completed. The summary provides details on net changes to cost, performance, and value, using the following calculations:

% Performance Improvement:	Δ Performance VA Alternative Set / Total Performance Original Concept.
Value Index:	Total Performance / Total Cost (in Millions)
% Value Improvement:	Δ Value Index VA Alternative Set / Value Index Original Concept

The rationale for the numerical rating change for each alternative is documented. The stakeholders are asked to validate the Performance Measures and rationale for ratings at the Implementation Meeting.

CONCLUSION

The development and integration of performance measurements into the value methodology employed on Caltrans studies has improved the effectiveness of the Value Analysis Program as applied to highway projects by providing a reliable, integrated method of measuring performance and, consequently, value. This in turn has allowed the program to more easily discuss implementation dispositions of alternatives, justify alternatives with cost increases, apply value analysis more effectively to projects in the earlier stages of project development, and to better capture input from participating project stakeholders.

SEGMENT 1 Tuesday, August 21
Kick-Off Meeting

8:30 – 10:30	Introductions, Project Presentation, Stakeholder Concerns Discussion
10:30 – 11:00	Performance Criteria Definition/Prioritization;
11:30 – 12:30	Rating of No-Build and Baseline
12:30 – 1:30	Lunch
1:30 – 5:00	Site Visit

Wednesday, August 22, 2001

8:30 – 9:00	Recap of Day 1
9:00 – 11:00	Function Analysis/FAST Diagram
11:00 – 11:30	Assign Costs to Functions
11:30 – 12:00	Creation of Ideas – Team Brainstorming
12:00 – 1:00	Lunch
1:00 – 2:00	Idea Creation (Continued)
2:00 – 2:30	Review VA Alternative Forms
2:30 – 4:30	Evaluation of Ideas

Thursday, August 23, 2001

8:30 – 11:30	Evaluation of Ideas
11:30 – 12:00	Lunch
1:00 – 4:00	Continue Idea Evaluation
4:00 – 4:30	Assign VA Alternatives to VA Team Members

Tuesday, August 28, 2001

8:30 – 9:00	Review Previous Week – Distribute Idea/Evaluation Lists
9:00 – 12:00	Alternative Development
12:00 – 1:00	Lunch
1:00 – 5:00	Alternative Development

Wednesday, August 29, 2001

8:00 – 12:30	Alternative Development
12:30 – 1:30	Lunch
1:30 – 3:30	Technical Review of VA Alternatives
3:30 – 5:00	Team Review of Alternatives

Thursday, August 30, 2001

9:00 – 10:00	Team Review of Alternatives
10:00 – 11:00	Team Prioritization and Evaluation of Alternatives by Sets
11:00 – 11:30	Prepare for Presentation
1:30 – 3:00	Presentation of VA Study Results to Management and Stakeholders

MEETING ATTENDEES *SR 101 Roadway Stabilization*										Caltrans			
August, 2001						2002	NAME	ORGANIZATION	POSITION	TELEPHONE		FAX	
21	22	23	28	29	30	9/26				E-MAIL			
X	X	X	X	X	X	X	Fred Kolano	Value Management Strategies, Inc.	Team Leader	970	242-5531	970	242-6784
										fred@vms-inc.com			
X	X	X	X	X		X	Dan Adams	Caltrans Structures Design	Substructure Committee Chair	916	227-8358		
										dan_t_adams@dot.ca.gov			
X	X	X	X	X	X	X	Gary Garofalo	Caltrans Geotechnical	Geotechnical Engineer	916	227-7190	916	227-7244
										gary_garofalo@dot.ca.gov			
X	X	X	X	X	X	X	Deborah Harmon	Caltrans Environment Planning	Branch Chief	707	445-6416	707	441-5775
										deborah_harmon@dot.ca.gov			
X	X	X	X	X	X		Mike Eagan	Caltrans Planning	Branch Chief	707	441-3937		
										mike_eagan@dot.ca.gov			
X	X	X	X	X	X		Jon Kaneshiro	Parsons ES	Tunnel Design	916	687-0400	916	687-0401
										jon.y.kaneshiro@parsons.com			
X	X	X	X	X	X	X	Susan Morrison	Del Norte Local Transportation Commission	Director	707	465-3878	707	465-5518
										morrison@delnortemail.com			
X	X	X	X	X	X		Aida Parkinson	Redwood National/State Parks	Environmental Specialist	707	882-7611 ext.5470	707	822-8904
										aida_parkinson@nps.gov			
X	X	X	X	X	X		Michael Stapleton	Caltrans	Project Engineer	707	445-6453	707	445-6651
										mike_stapleton@dot.ca.gov			

F = Full Time, P = Part Time

MEETING ATTENDEES *SR 101 Roadway Stabilization*										Caltrans			
August, 2001						2002	NAME	ORGANIZATION	POSITION	TELEPHONE		FAX	
21	22	23	28	29	30	9/26				E-MAIL			
X	X	X	X	X	X		Doug Jackson	Caltrans Structures Construction	Resident Engineer, Structures Redesign	707	825-0195	707	825-0754
										doug-jackson@dot.ca.gov			
X	X				X	X	Gary Banducci	Caltrans	Project Manger	707	445-6440	707	441-5733
										gary_banducci@dot.ca.gov			
X				X	X	X	Dennis McBride	Caltrans	Design Manger	707	441-5878		
										dennis_mcbride@dot.ca.gov			
X					X		Tim Boese	Caltrans – District 1 Traffic Operations	Leadworker Traffic Operations	707	445-6689		
										timothy_l_boese@dot.ca.gov			
					X		Ilene Cooper	Friends of Del Norte County					
					X	X	David Finigan	Del Norte County Board of Supervisors	County Supervisor Local Transportation Commission	707	464-7204	707	464-7663
										dfinigan@harborside.com			
X	X				X		Jerry Hanson	California Trucking Association	Consultant Membership Services	707			
										jhansen@xprs.net			
X							Ruskin Hartley	Save the Redwoods League	Conservation Planner	415	279-9100	707	279-9115
X							Starr Kilian	Caltrans – District 1 Right-of-Way	Right-of-Way Agent	707	445-6423	707	441-5870
										starr_kilian@dot.ca.gov			

F = Full Time, P = Part Time

MEETING ATTENDEES *SR 101 Roadway Stabilization*										Caltrans	
August, 2001						2002	NAME	ORGANIZATION	POSITION	TELEPHONE	FAX
21	22	23	28	29	30	9/26				E-MAIL	

F = Full Time, P = Part Time

MEETING ATTENDEES *SR 101 Roadway Stabilization*										Caltrans			
August, 2001						2002	NAME	ORGANIZATION	POSITION	TELEPHONE		FAX	
21	22	23	28	29	30	9/26				E-MAIL			
X					X		Ralph Martinelli	Caltrans – District 1 Traffic Operations Branch	Traffic Safety Chief	707	445-6376	707	441-5626
										ralph_martinelli@dot.ca.gov			
X					X	X	Ernie Perry	Del Norte County Community Development	Director	707	464-7254		
										eperry@co.del-norte.ca.us			
					X		John Carson	Caltrans	Traffic Operations Chief	707	445-6377	707	441-3914
										John_carson@dot.ca.gov			
X					X		Chris Wills	California Division of Mines and Geology	Senior Engineering Geologist	916	323-8553		
										cwills@consrv.ca.gov			
X					X		Oscar Vasquez	Caltrans	VA Coordinator	916	274-6111	916	274-5855
										oscar_vasquez@dot.ca.gov			
						X	Bob Baker	Caltrans	Geotechnical Branch Chief	707	441-3994		
										Bob_baker@dot.ca.gov			
					X	X	Rick Knapp	Caltrans – District 1	Director	707	445-6445		
										Rick_knapp@dot.ca.gov			
						X	Cheryl Willis	Caltrans – District 1	Deputy District Director – Planning	707	445-6413	707	441-5869
										Cheryl_willis@dot.ca.gov			
						X	Marty Van Zandt	Caltrans – District 1	Deputy District Director – Maintenance and Operations	707	445-6393	707	445-6626
										Martin.van.zandt@dot.ca.gov			

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MEETING ATTENDEES *SR 101 Roadway Stabilization*										Caltrans			
August, 2001						2002	NAME	ORGANIZATION	POSITION	TELEPHONE		FAX	
21	22	23	28	29	30	9/26				E-MAIL			
						X	Charlie Fielder	Caltrans – District 1	Deputy District Director - Administration	707	445-6490		
										Charlie_fielder@dot.ca.gov			

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MEETING ATTENDEES *SR 101 Roadway Stabilization*										Caltrans	
August, 2001						2002	NAME	ORGANIZATION	POSITION	TELEPHONE	FAX
21	22	23	28	29	30	9/26				E-MAIL	

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Caltrans

Value Management Strategies, Inc.

Value Analysis Report

SR 101 ROADWAY STABILIZATION

CALTRANS DISTRICT 01 – DEL NORTE COUNTY, CA

Contract 53A0063
Task Order 204.183

October 2002

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